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THE EVOLUTION OF THE DUNEDIN HOSPITAL AND MEDICAL SCHOOL: A BRIEF HISTORY.

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EIGHTY years or so ago the picturesque area of bush-clad country at the head of the Otago Harbour (Otakou in Maori language) was practically unknown, except to the native inhabitants and a few adventurous whalers and sealers.

The earliest actual Otago colonists came out in 1848 under the management of the New Zealand Company. They were in the main Scottish people belonging to the recently seceded Free Church, and they brought with them their own minister (the Reverend Thomas Burns, a nephew of the poet), and a planned determination to foster the religious and the educational ideals of their homeland.

They tackled their pioneering difficulties with marvellous courage and enterprise, and by the year 1861, with the aid of the later-coming immigrants, Dunedin had grown to be a town of some three thousand inhabitants, with extensive hospital accommodation consisting of a ramshackle collection of buildings in the Octagon, where the back part of the Town Hall now stands.

In 1861 began the dramatic Otago gold rush, and many thousands of gold seekers, traders and adventurers streamed into Dunedin from California, Australia and elsewhere on their way to the El Dorado of Gabriel's Gully and other alluvial fields situated sixty or seventy miles inland.

Dunedin, in an incredibly short space of time, increased its ordinary population to sixteen thousand, and became the largest and most important town in New Zealand. Shiploads of transients awaiting and preparing for their transport to the gold diggings and camped in barracks, tents and huts, swelled the crowded population to thirty thousand or more. Sanitation was awful, as can easily be imagined, accidents and bloody fights were numerous, and the hospital had to find room for over one hundred and fifty patients, not counting the forty or fifty mental patients who were also housed there.

Dr. Edward Hulme was the medical officer in charge, and in that capacity he served the hospital faithfully and well from the year of his arrival in New Zealand (1856) until his death in 1876. Hulme, in his student days, was dresser to Sir Charles Bell at Middlesex Hospital, and he also learned surgery from Sir Astley Cooper, Cline, Liston, Velpeau and others. He won the Jacksonian Prize in 1848 for an essay on asphyxia. Before coming out to New Zealand he practised for some years in Exeter. Hulme was evidently highly thought of in England by the Royal College of Surgeons, which body accorded him a fellowship without examination in 1866.

FIGURE I. Showing Dunedin Hospital. The central block with tower built in 1864 is soon to be replaced by a modern structure. In the foreground facing the hospital can be seen the excavations for the new Medical School built in 1926.

By 1864 Dunedin had made encouraging progress, and in the early part of that year an ambitious and very successful exhibition of industry and art was organized and housed in a large and imposing brick building with towers and clock and various wooden annexes, all specially erected for the purpose on the present hospital grounds at a cost of £18,000.

The moving spirit in this venture and the Secretary of Committee was Dr. Alfred Eccles, who had come out to New Zealand at the time of the gold rush in 1861.

Alfred Eccles was a "Bart's" man and a close friend of Sir James Paget, and did so well in his surgical work that he was elected in 1845 amongst the first chartered Fellows of the English College. He prac-

tised for ten years in Dunedin, and was one of the most, if not the most, useful and progressive citizens of his time. When the exhibition was over, Eccles, with his customary energy and foresight, persuaded the authorities not to use the buildings for a market, as was the original intention, but to convert them into a commodious and much needed hospital to replace the overcrowded and unsuitable institution in Moray Place.

Accordingly, towards the end of the year 1866 Dr. Hulme transferred 123 of his patients to their new location, and from this beginning the Dunedin Hospital as we now know it has evolved. The rather attractive looking central block is the only part of the original exhibition buildings still standing, and this also having outlived its usefulness, is now to be pulled down and will give place to a modern structure.

In 1867 Hulme had the assistance of a resident medical officer, Dr. Yates, and the services of an honorary visiting staff consisting of Dr. T. M. Hocken (the historian) and Dr. R. Burns. Later Dr. Alexander replaced Dr. Burns.

In 1872 the antiseptic treatment of wounds by carbolic acid according to the teaching of Lister was introduced at the Dunedin Hospital, and the circumstances were so unusual as to merit record.

A young member of the well-known family of the Fultons, while working at a flax-scutching mill, had his left arm drawn into the machinery and a very severe compound comminuted fracture resulted. The patient was taken to the hospital and was there visited by a close friend of the Fultons, Dr. Duncan Macgregor, Professor of Mental Science at the newly established University of Otago. Macgregor, although devoted to the study of philosophy, had studied medicine at Edinburgh and obtained his M.B., C.M. degree there. He had seen Lister at work, and realized the immense value of his researches and antiseptic technique. In Fulton's case he visualized the possibility of saving the arm by the employment of the Listerian methods. He pleaded with the hospital doctors to give this new technique a chance before deciding on amputation, and offered to carry out the details of the treatment with his own hands. So earnest were his arguments and so liberal-minded were the hospital officers, that Macgregor, though not on the medical staff and not even in medical practice, was given charge of the case. The arm was saved, though it took nine months to heal completely and the elbow remained permanently ankylosed. Nevertheless, Fulton was afterwards able to play cricket and tennis and play them well, and he lived to a good old age.

Gradually the old order of things has given place to the new. The milestones of surgical progress have been passed one by one until the stage of the modern hospital has been reached with its extensive aggregation of ward pavilions, theatre blocks, laboratories, radiology and specialist departments, nurses' home, auxiliary institutions, and all the attendant paraphernalia and organization.

Dr. W. S. Roberts, who is now retired from practice, but who was closely concerned with the fortunes of the hospital and Medical School in their earliest years as resident surgeon and as teacher of pathology, gives the following personal reminiscences:

When, in August, 1878, I succeeded Dr. Tighe (who had died of phthisis) and commenced duties as Resident Surgeon in the Dunedin Hospital, it was a

single four square building which had been adapted from what was originally built in 1864 as an exhibition. At that time the conditions were primitive, even for those days. There were six male wards, two female wards, and two small rooms, one male and one female, for venereal cases. There was also a wooden annex for chronic and incurable cases (males), and a small maternity ward with six beds presided over by a matron. The wards were not specially differentiated into medical and surgical cases, the cases being more or less mixed. The nursing staff consisted of one male warder for each male ward, and one female nurse for each female ward, and one male night warder and one female night nurse. None of these had received any previous hospital or sickroom training. There was a tin shed situated in the grounds in which lived and died three Chinese lepers. The honorary medical staff consisted of three surgeons, Drs. F. C. Batchelor, H. W. Maunsell and Wm. Brown. The physicians were Drs. de Zouche, Borrows and Blair. There were no specialists. The operating room was also the casualty room, with wooden table and ordinary wash hand basins. It was heated by steam. The out-patient department was situated in the wooden annex. This annex was also used as a drying place for the laundry. No special operating costume was used, but the frock coat covered with blood splashes, which at no distant date it was the custom to use, was abandoned; the operator merely removed his coat and tucked up his shirt sleeves. Operations were confined to external parts only. The abdomen was never opened. Appendicitis was unknown, and when present was called typhlitis. There were no attempts at asepsis or antisepsis beyond the use of carbolic lotion and, a little later, carbolic spray. Suppuration was usual and healing by first intention was considered a triumph. Arteries were dealt with by torsion, or were seized by ordinary forceps and tied with silken ligatures, which were left long and kept hanging outside the wound, to be removed later. Drainage tubes were used. Sutures were either silver wire, silkworm gut or horsehair. Esmarch's elastic bandage was frequently used on extremities. Dressings consisted of wet carbolic lint, tow and diachylon plaster. The infectivity of phthisis was not recognized; such patients occupied the general medical wards and no precautions were taken. Typhoid cases were frequent and also cases of *delirium tremens*. Operating instruments were merely washed in hot water after use and kept in a wooden cupboard.

Amongst the students attending hospital in these early days was Dr. Wm. John Mullin, retired from practice and now Medical Librarian to the Otago School.

Dr. Mullin's recollections will usefully supplement those of Dr. Roberts.

I started work in the hospital as a dresser in 1885. My impression of the Dunedin Hospital at this time—nearly fifty years ago—is that, though the building was perhaps ill-adapted for a hospital and the arrangements such as we now would think primitive, the surgical and medical practice was remarkably up to date for such a small and remote centre. We were in the full tide of the carbolic era—all instruments were soaked in one in 20 carbolic solution, sponges were left in it all night and carbolic sprays charged the atmosphere of the operating room with clouds of steam and carbolic acid. The operators were cleanly men who washed their hands well with soap and hot water before dipping them in the ritual carbolic solution. There was no such thing as operating in an old blood-stained frock coat, though I understand that at least one eminent Edinburgh surgeon did so in 1885.

The operating room was certainly a weak spot in the system. It served also as a casualty room for minor surgical cases. Students congregated there to dress casualty cases and wait for their surgeons and physicians. A big bunch of horsehair sutures hung on the gas bracket, open to the airs of heaven and to any dust that might come with them. If anyone wished to suture a wound he plucked a sufficient number of horsehairs from the bunch and put them to soak for a few minutes in the inevitable one in 20 carbolic solution. An up-to-date

operating theatre was built in 1888. In '86 or '87 I remember Dr. Batchelor operating in an empty ward because of his distrust of the old operating room. The surgeons who impressed me most were Drs. Maunsell and Batchelor. They were both remarkably able men. Between 1885 and 1890 the Dunedin surgeons had got over their awe of the peritoneum and opened the abdomen freely when it was required; but I never heard the term "appendicitis" used till after I was qualified, nor was I, as a student, aware that some surgeons in Europe had started to remove the appendix by operation in cases of perityphlitis. I never heard of "adenoids" till after my final examination. In the early nineties I heard of "post-nasal growths" and remember seeing an operation for their removal in 1892.

In the late eighties tonsils were removed in the hospital by Mackenzie's guillotine without anæsthesia, the patient sitting in a chair.

Dr. Lindo Ferguson's ophthalmic department was always busy and operations were frequent—cataract extractions, needlings and iridectomies *et cetera*.

Two operations in 1885 and 1886 still remain vividly in my memory: Dr. Maunsell removing an enormous fibro-myomatous uterus and beaming on the eighteen and one-quarter pound tumour afterwards, through his very concave glasses; Dr. Batchelor making an exploratory laparotomy and finding a large and very putrid extrauterine fœtus of some months' growth. Both these patients lived and did well afterwards.

Amputations were not common, but resections of joints were done fairly often.

During this period the attendants in the male wards were "handy men"—ex-policemen, ex-asylum attendants, and others who were not robust enough to work with pick and shovel. William Dryburgh, the hall-porter, an ex-naval man, was a great character in his way. He prided himself on being one of the sailors who carried Florence Nightingale on the stretcher to the transport at Scutari when she was stricken with fever. He died in 1902 after thirty-eight years' faithful service, and kept a careful diary in a large illiterate handwriting, with notes of all admissions, discharges, deaths, *post mortem* examinations and operations. He actually, for a time, did the technical part of the *post mortem* examinations himself and passed catheters when necessary.

Typhoid cases were treated in the general wards—so were consumptives. The physicians did not really approve of this last, but there was no other place for them to go. The first sanatorium came years after, and was a private affair run by a Dunedin doctor.

THE UNIVERSITY OF OTAGO AND THE MEDICAL SCHOOL.

The province of Otago established a University at Dunedin as soon as the population justified this aspiration of the early settlers, and by 1871, long before any other town in New Zealand had thought of such a thing, arts classes were in full swing, with an attendance of seventy or eighty students. The building used for the first few years as a university is that large and rather ornate structure of the wedding-cake type of architecture situated in the very centre of the town and now known as the Stock Exchange and previously as the Colonial Bank. It was originally built for a post office, and the clock that usefully adorns its tower was removed from the exhibition building in 1864 when this became the hospital, and a very inferior one was substituted which has never merited confidence. The progress of the University speedily revealed the shortcomings of this adapted building, and in 1880 the present specially erected block of buildings in stone and brick on the banks of the Water of Leith became the academic centre for the study of the arts and sciences.

Additional buildings had soon to be erected in the University grounds to accommodate the requirements of Medical, Dental and Mining Schools, and later it was found expedient to provide entirely new homes for both the Medical and Dental Schools in the immediate vicinity of the hospital in King Street.

The first student of the Otago University to enrol was Sir Robert Stout, one of New Zealand's most eminent statesmen, and the father of Duncan and Robert Stout, who are both Fellows of the Royal Australasian College of Surgeons. The first to graduate in arts was W. A. Williamson, in 1874, and, as in that year the Otago University became

FIGURE II. Showing the University of Otago, main building facing Castle Street, Dunedin.

affiliated as a college to the newly formed University of New Zealand, Williamson, who is still living, represents its one and only graduate. All Otago graduates from this time on, obtained their diplomas from the University of New Zealand, which was then established as the examining body for the whole colony.

Medical classes were contemplated from the first, but there was some natural hesitation and some actual opposition to be overcome, and it was not until 1875 that the first lectures in chemistry (Jas. Gow Black, M.A., D.Sc.), zoology (Fred. K. W. Hutton, F.R.S.) and anatomy (Millen Coughtrey, M.B., C.M., Edin.) were given, and the hospital opened its doors for the clinical instruction of medical students. Dunedin Hospital at this time had 190 beds, and there were 72 others

at the Benevolent Institution where indigent and chronic and senile patients were housed.

The next largest hospital in New Zealand at that time was Auckland, with 77 beds. (Today Dunedin Hospital has about 300 beds and Auckland more than twice as many.)

The beginnings of the Medical School were not at all encouraging, and there were great difficulties in getting any sort of recognition by university or college councils in Great Britain.

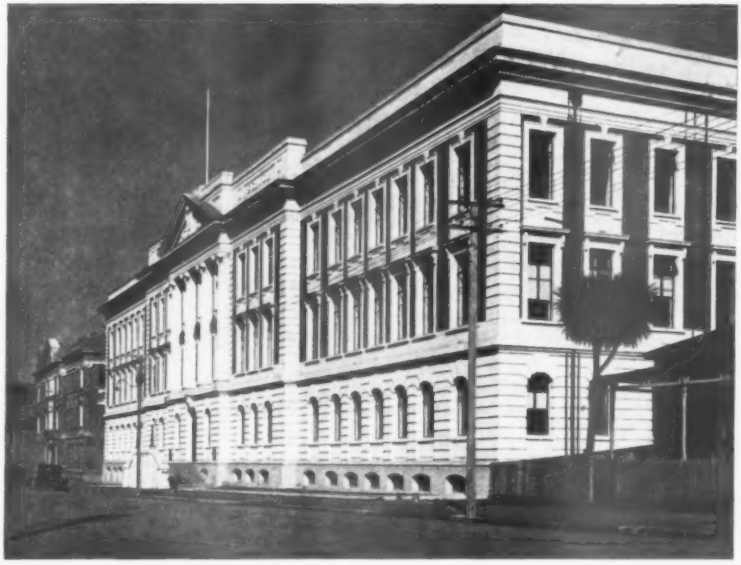

FIGURE III. Showing the Otago Medical School buildings opposite to the hospital, King Street, Dunedin.
[*Photograph by George Chance.*

Dr. M. Coughtrey, who had come out to New Zealand in 1874, and had been appointed Lecturer on Anatomy the following year, had but one student (the late Dr. Charles Low, of Invercargill), and was so dissatisfied with the prospects of success that he resigned his teaching appointment and went into private practice in Dunedin. The University Council in 1877 appointed Dr. J. H. Scott as Professor of Anatomy and Lecturer on Physiology, and from this time the Medical School began to feel its feet, and in a few years, under Scott's wise leadership, became firmly established.

John Halliday Scott, M.D. (Edin.), M.R.C.S. (Eng.), was a Senior Demonstrator in Anatomy under Professor Sir Wm. Turner at Edinburgh University, and twenty-six years of age when he received his

Dunedin appointment. (D. J. Cunningham, a junior demonstrator, who later succeeded Turner as professor, was also a candidate for the position.) Scott's first class held in the year 1878 consisted of the following five men: W. J. Will, F. G. Westenra, Herbt. MacAndrew, J. A. J. Murray, and J. O. Closs, and of these the only survivor is Dr. Murray, now living at Lindfield, New South Wales.

Scott proved an ideal teacher as well as a capable organizer, and was, in 1890, made Dean of the newly instituted Medical Faculty, a position he held to the time of his death in 1914. No man, with the exception of his successor in the deanship of the Faculty of Medicine, Sir Lindo Ferguson, has exerted so marked an influence in the progress of the school, and all old pupils speak of him with gratitude and affection.

In 1878, Dr. Wm. Brown was appointed Lecturer in Surgery, and other classes also were instituted at the Medical School, enabling it to reach a standard that justified Edinburgh University in recognizing the first two years of the course provided in New Zealand. Dr. Brown taught surgery at the Medical School and at the Dunedin Hospital for thirteen years, and taught it well on sound and cautious lines. He took a special interest in the welfare of children, and was chiefly responsible for the establishment of the children's wards in 1899.

D. Colquhoun, M.D. (London.), F.R.C.P., now retired, was appointed Lecturer and later Professor of Medicine in 1883. He did much to improve the nursing system at the hospital, and it was due to him that the old time warders who looked after the male patients and whose work was good only in parts, were replaced by the modern type of trained female nurses. Dr. Colquhoun, however, says that his most useful contribution to hospital progress was the definite partition of hospital patients and staff into the two main groups, medical and surgical. Formerly, a go-as-you-please arrangement prevailed, and medical patients might be treated by surgeons and operations performed by physicians. He himself did operations on occasion, including a nephro-lithotomy that ended well.

Dr. Ferdinand Campion Batchelor (whose son is F. Stanley Batchelor, now Senior Surgeon of the Dunedin Hospital) was appointed Lecturer in Obstetrics and Gynæcology in 1883, and quickly made and justly earned a great reputation for abdominal surgery. He published his first series of 100 laparotomies as far back as 1891. He was a man of striking figure and dynamic personality and he worked incessantly for progress. By his efforts, which were backed up by the report of a Royal Commission in 1890, and by generous public contributions of money, new surgical wards were built and the nursing system was greatly improved. Dr. Batchelor will be well remembered by many of the older practitioners as the President of the Australasian Medical Congress held in Dunedin in 1896. He died in 1917 after a particularly trying year of war service in Egypt.

In 1884 Henry Lindo Ferguson, C.M.G., M.A., M.D., F.R.C.S.I., joined the hospital staff as Ophthalmic Surgeon and in 1886 became the

University Lecturer, and later Professor in Ophthalmology. Now, after fifty years of devoted and most valuable service, he still holds these positions, and has been Dean of the Medical Faculty since 1914. It is mainly owing to his efforts that the new Medical School buildings opposite to the hospital were established, and that the progress and prestige of the school have reached their present gratifying position. The medical course has been maintained at a standard comparable with that of schools of the highest repute in other parts of the British Empire, and this fact has been duly appreciated by the New Zealand people, for of the 1,460 doctors on the New Zealand Register, 50% have New Zealand qualifications and a large number have taken a partial course at the Dunedin School. Sir Lindo Ferguson received the honour of knighthood in 1924.

In 1889 Henry Widenham Maunsell was the Lecturer on Surgery. He was a bold and original surgeon, and his method of performing intestinal resection, first published in *The American Journal of the Medical Sciences*, March, 1892, was described and approved in all the leading textbooks. He used to say that the inside-out technique which is the feature in this ingenious operation, was suggested to him by the method he saw his wife employing when fastening the sleeve of a dress to the rest of the garment.

Maunsell also originated a flap method of amputating the tongue and a new technique for cleft palate operation in which he used wood-carver's tools when reconstructing the bony defect in the hard palate. He left New Zealand in 1891, hoping to establish a surgical practice in London, but death from an acute illness some two years later brought his brilliant career to an untimely end.

In the year 1896 a contribution of some note dealing with the operation of partial thyreoidectomy for exophthalmic goitre was made by one of the Dunedin Hospital surgeons, Dr. J. O. Closs, who, it will be remembered, was one of the first medical students of the Otago School. He published in the "Transaction of the Intercolonial Medical Congress", 1896, page 160, a record of four cases in which he had operated, and although one of them ended fatally, Closs showed that surgical intervention was in certain circumstances fully justified.

The author's (L. E. Barnett's) long connexion with the school has been, for the most part, ordinary, but one or two points might have some historical interest. He has been in turn a patient, a medical student, a physician and a surgeon to the Dunedin Hospital, and his son is now one of the assistant surgeons.

As a very small child attending the old Stone School he suffered a dislocation of his right elbow and received appropriate first-aid at the Dunedin Hospital at the hands of Dr. Hulme.

In 1883 and 1884 he was a medical student at Dunedin, and received instruction in anatomy and physiology from Professor J. H. Scott, in botany and zoology from Professor T. Jeffrey Parker, in chemistry from Professor Jas. Black, in surgery from Dr. Wm. Brown, in clinical

surgery from the last mentioned and others on the hospital staff, including Dr. W. W. Roberts, the resident medical officer, in ophthalmology from Dr. Lindo Ferguson, and in dispensing from Dr. John Brown.

FIGURE IV. Group photographed in December, 1933, of five veterans all associated with the Otago Medical School for fifty years or more. Top row (from left to right): Sir Louis Barnett, Sir Lindo Ferguson, Dr. D. Colquhoun. Front row: Dr. W. J. Mullin, Dr. W. S. Roberts.

In 1891 Barnett lectured on surgery and was one of the hospital surgeons as *locum tenens* for Dr. H. W. Maunsell. In 1892 he lectured on medicine and was one of the hospital physicians as *locum tenens* for Dr. D. Colquhoun. In 1894 he succeeded Dr. Wm. Brown as Lecturer

on Surgery, was given his professorship in 1906; and in 1925 retired at the age of sixty after thirty-three years of service in the Medical School and hospital. He was the first New Zealander to obtain the English fellowship by examination (1890); the first to visit the Mayo Clinic (1904); and the first to wear rubber gloves and gauze mask as a routine in operative work in New Zealand (1905).

The first of the Otago students to graduate in medicine at the Otago Medical School was Wm. Ledingham Christie, of Warepa. This was in the year 1887. Christie afterwards practised in England and in the East Indies, and died at sea some years ago. Since his time 869 others have graduated as M.B., Ch.B. (N.Z.), 56 have obtained the M.D. degree and seven the Ch.M. (N.Z.), and of the 73 Fellows of the Royal College of Surgeons of England residing in New Zealand, 50 have been students at the Otago Medical School.

ACKNOWLEDGEMENTS.

The writer expresses his debt of gratitude to the late Dr. Robert Fulton for details regarding the lives of the doctors who were first associated with the Dunedin Hospital, information which is published in most interesting fashion in his book "Medical Practice in the Early Days" (Otago Daily Times Company), and also to Dr. George E. Thompson, whose book "History of the Otago University" (Coulls, Somerville and Wilkie, Dunedin) is deservedly a classic on the subject.

Thanks are also tendered to Mr. W. F. Simpson, photographer, 27 Cargill Street, Dunedin, and to Mr. George Chance, 10 Lynwood Avenue, Dunedin, for the photographs supplied.

GOITRE IN OTAGO.

By Frank Fitchett, C. E. Hercus and F. Gordon Bell.
(From the Goitre Clinic, Dunedin Hospital.)

WITH NOTES ON PATHOLOGY.

By E. F. D'Ath.

Goitre is endemic in New Zealand as a whole. The endemicity varies from district to district and is of long standing, thyreoid disease having been prevalent among the Maoris before the advent of Europeans. The Province of Otago is one of the more highly endemic areas, and goitre has been prevalent in the European population since the earliest days of settlement. Strangers visiting the capital city of Dunedin invariably remark upon the large number of goitrous women met with in the streets, in public conveyances, and wherever people are congregated. Striking evidence of the frequency of goitre is afforded by examination of the school population, of recruits, of nurses in hospital, and of patients admitted to hospital and asylum.

Toxic goitre is also common, and that this is not a recent manifestation is shown by the fact that as far back as the Australasian Medical Congress held in Dunedin in 1896, Dr. J. O. Closs, of Dunedin, reported several cases of Graves's disease which he had submitted to partial thyreoidectomy, with, for the period, gratifying success, and put up a plea for the physician early to recognize that Graves's disease is one for surgical treatment and consequently for early operation. Closs was before his time in this plea, and his paper has never received the recognition it merited.

The incidence of toxic goitre shows a positive correlation with the endemicity of simple goitre. This relationship contrasts sharply with that of such regions as the Alps and the Himalayas, where toxic goitre is rare, and agrees with the findings in the endemic areas of North America, Norway and Holland. From communications to the Australasian Medical Congress held in Dunedin in 1927 the striking difference in the death rate between Australia, where endemic goitre is comparatively rare, and New Zealand, where it is common, became apparent; it was shown that the deaths from toxic goitre per thousand total deaths for the period was 1·30 in the Commonwealth, as compared with 3·40 in the Dominion.

In April, 1927, the Honorary Medical Staff of the Dunedin Hospital set up a committee (Professors of Clinical Medicine, Preventive Medicine, Pathology and Surgery, and the Senior Surgeons to the Hospital acting in rotation) to investigate all cases of thyreoid enlargement passing through the hospital. At the end of the first year of study a brief

progress report was published, and the committee now present a statement of their observations and conclusions after six years' consecutive work. In this review we make no attempt to consider goitre in all its aspects, but are content to submit a study of thyreoid disease as it presents itself in a hospital situated in a highly endemic district on the fringe of the world. No reference is made to cases occurring in our private practices, except in so far as they illustrate some special point.

In preparing this paper the writers have encountered the usual difficulties which collaboration entails; furthermore, they have had difficulty in presenting it in a form palatable to the reader whose interest is intensely surgical and wholly practical, and yet in retaining detailed information on points of more academic interest. In consequence, many laboriously prepared tables have been omitted and general statements have been substituted.

METHODS OF STUDY.

In our practice every goitrous patient is admitted to an annexe of a medical ward under a physician for full investigation. The routine observations include, in practically all cases, repeated metabolic estimations, glucose tolerance, electrocardiogram, radiological and laryngological examination; blood is taken for iodine estimation before any treatment with iodine is begun, and for the first two years an attempt was made to estimate quantitatively the amount of iodine ingested daily, and this figure was compared with the total iodine excreted in urine and fæces, but this balance experiment has been given up. After operation, all thyreoid tissue removed is weighed, and the iodine content estimated prior to histological examination.

The basal metabolic estimations are made with the Roth apparatus, which we believe offers an advantage over the Douglas bag, in that repeated tests can be made at one sitting; but we recognize that the fixed respiratory quotient may lead to inaccuracy in the lower readings. Tests are made by a specially trained nurse on three successive mornings, beginning on the day after the patient's admission to hospital. The first test is regarded as a trial run and the result is rejected. The figures obtained with the two subsequent tests are averaged, and the result is regarded as the basal metabolic rate on admission. Thereafter, the rate is taken once a week or oftener if indicated. Twice before discharge after operation the rate is again taken. In our earlier work we used the Goetch test and Read's formula in addition, but dismissed these methods as unreliable. We regard *plus* rates from 10 to 20 as being practically normal in themselves, but, if repeated and taken along with suggestive clinical features, as indicative of mild toxic goitre.

As we recognize that the treatment of established goitre is predominantly surgical, the rôle of the physician is directed chiefly to diagnosis and preparation of patients for operation. Once a week the committee visits all inmates in consultation, determines the advisability and time of operation, and interviews patients called up on the follow-up system. Patients are requested to report one month after discharge and

thereafter at the third, sixth, twelfth and twenty-fourth months, when they are classified under the following headings: No better—still invalid; better—able to do some work; cured—in full work.

In this small community the follow up has worked well and patients report very satisfactorily.

Periodically the cases are reviewed in the light of the pathological and surgical reports, and an attempt is made to correlate the pathological and clinical diagnosis.

During the period, 368 patients have passed under review. They have been studied with great care and, though gaps exist here and there in points of detail, we believe that the study as a whole gives an accurate picture of goitre as we see it in this part of the world, and so may have its value.

We propose to discuss the series under the following headings: 1. Classification. 2. Individual summary of various types, with a review in each of points of special interest. 3. Circulatory disturbance in toxic goitre. 4. The use of Lugol's solution. 5. The applications of radiotherapy. 6. Surgical procedures. 7. Complications attending operation. 8. Pathology and biochemistry.

CLASSIFICATION.

We acknowledge the difficulty universally voiced of reaching an entirely satisfactory classification of goitre, and we subscribe to that opinion with regards the different forms as manifestations of one and the same disease. The clinical picture, particularly of toxic goitre, may be aptly compared with the spectrum with its sharply defined colours and its intermediate shades. No one has argued this more convincingly than Dunhill,[1] who writes of toxic goitre:

> We have tried to force cases into a type, and it has left us with the uneasy feeling from time to time that a case would not fit in, notwithstanding that many did so readily.

Later he declares:

> My belief now is that a full range of cases exists representing every stage between exophthalmic goitre at one end and toxic adenoma at the other.

This view was voiced by various contributors to the International Goitre Conference at Berne (1927), though others differed sharply and would place primary Graves's disease in a class apart. We share the suspicion expressed by some authorities that the ultimate cause of thyreotoxicosis lies beyond the thyreoid gland. We admit that the thyreoid usually plays a predominant, often overshadowing, part in the production of symptoms which are quelled by its adequate resection; but suspect some unknown noxa or genetic factor which disturbs the endocrine system as a whole, and by the variability of its point of attack confuses the diagnosis and complicates the classification. If we accept the usual connotation of the term "simple goitre" as implying a pathological thyreoid enlargement which produces no toxic symptoms,

then the goitre of relatively few of the patients admitted to our hospital can be classed strictly as simple. A majority of all forms of the disease show toxic symptoms in greater or less degree (latent thyreotoxicosis). It is the discomfort and alarm associated with the appearance of these symptoms that have driven them to hospital. This is true of many of the cases we have classed as simple, and if we have retained them in the simple class it is because the symptoms were relatively trivial and the basal metabolic rate was not raised or only slightly raised. Simple diffuse goitres in young persons and nodular goitres in patients admitted ostensibly for the relief of pressure symptoms have very generally produced symptoms such as palpitation, nervousness, tremor, mobile pulse, vasomotor disturbance, and anomalies of carbohydrate metabolism, slight indeed, but recognizable, which, if more pronounced and associated with an elevated metabolic rate, would have excluded them from the simple class. We are speaking, of course, only of hospital cases, and are well aware that in this endemic district these are greatly outnumbered by simple diffuse and simple nodular goitres which produce no recognizable toxic symptoms, and whose presence, unless they press upon the trachea or offend against appearance, is a matter of indifference to the patient.

Under the caption "Simple Goitre" we recognize simple diffuse and simple nodular. As our classification is a clinical one, we do not subdivide simple diffuse goitre into simple parenchymatous and simple colloid, for these are generally indistinguishable clinically. Further, the simple diffuse goitres seldom come to operation, and among those in our series upon which an operation was performed, there was no example of simple parenchymatous goitre. All were colloid. Neither do we subdivide the simple nodular goitres, for whether the nodules are small and freely distributed in a symmetrical thyreoid enlargement, or large, single, or few in number producing an asymmetrical thyreoid enlargement, is a matter of no practical moment. The pathogenesis, except in rare instances, is the same.

The difficulty in classifying is greater with the frankly toxic goitres. Under the captions "Primary Graves's Disease" and "Secondary Graves's Disease", meaning by "primary" the contemporaneous appearance of local changes and general symptoms in a patient with a presumably healthy thyreoid gland, and by "secondary" the appearance of toxic symptoms in a patient with an abnormal but hitherto inoffensive thyreoid, we have tried, indeed have spent much time in endeavouring, to determine in which of these classes a large number of our cases should be placed. Several difficulties present themselves. One is in determining whether the thyreoid gland was previously healthy, an essential requisite for the diagnosis of primary Graves's disease if the above definition of it is to hold. Taking thyreoid enlargement as evidence of disease, the question turns upon the duration of the goitre and for this information we must rely upon the statements of the patient. Even with intelligent and observant patients the evidence is often uncertain, while with those of the class which supplies the greater number of our

patients, domestic servants, wives of general labourers, it is often inadmissible. Many are unaware when the question is put that they have a goitre, others are unable to say with conviction whether it has been present ten months or ten years. Moreover, patients suffering acute symptoms of toxæmia are not good subjects for the close cross-questioning that is necessary if reliable evidence is to be obtained.

Very close analysis is often necessary with a history of long standing goitre to determine whether the case is one of secondary Graves's disease or of recurrent primary Graves's disease. In several cases classed first as secondary Graves's disease because the goitre was of long standing and symptoms of recent origin were only admitted by the patient, additional evidence derived either after close questioning from the patient herself or from her friends has shown that, when the goitre first appeared, it was associated with symptoms comparable to those now present, and it becomes clear that the case is really one of recurrent primary Graves's disease.

One patient in our series with a goitre history of upwards of twenty years, but with symptoms of nine months' duration only, had been under the care of one of us in this hospital twenty-two years previously. Her symptoms disappeared under medical treatment, but the goitre and proptosis remained.

Looking back, it is clear that this was a case of primary Graves's disease. Had personal recollection and the hospital record not been available, this later manifestation of toxicity would have been classed as secondary Graves's disease.

Even if the evidence of the duration of the goitre is acceptable, what interval between the appearance of the goitre and the appearance of symptoms is allowable in making a diagnosis of primary Graves's disease? We can record very few cases in which the appearance of each was simultaneous. In our series originally classed as primary Graves's disease, in 52 cases the duration of the goitre was 56 months, of symptoms 21 months, an average interval between goitre and symptoms of three years. If three years, why not thirty, if the clinical picture is strictly that of primary Graves's disease? Indeed, in one of these cases the goitre, diffuse in character, dated from childhood, a duration of thirty years, but symptoms were of recent origin. On this account we originally classed the patient as suffering from secondary Graves's disease, but, as in every other respect she presented a typical picture of primary Graves's disease, after much debate we moved her into that class. The patient died after ligature of one superior thyreoid artery. On the whole, we find that the duration of the goitre is a very unsatisfactory factor in determining the classification and we have abandoned it.

Another difficulty is that the clinical features of each class are not often distinctive. There are, of course, striking examples on either side which present no difficulty. A young normal subject who develops, often suddenly, a moderate firm diffuse goitre associated with definite eye signs and symptoms of hyperthyreoidism, is clearly suffering from primary Graves's disease. An older subject with a long standing nodular goitre who develops symptoms of hyperthyreoidism, is as clearly suffering from

secondary Graves's disease. But if we exclude the nodularity of the goitre (and nodularity is not always recognizable clinically), there is no clinical feature of one class that may not be present in the other. Eye signs, for example, which are emphasized by many authorities as a distinctive feature of primary Graves's disease, we find to be present in 75% in our series of cases of secondary Graves's disease. It is true that, as a rule, they are not so pronounced as in primary Graves's disease; but several of our cases which fulfilled all the requirements for a diagnosis of secondary Graves's disease, showed eye signs as well marked as in any of the primary Graves's disease class.

As already stated, our classification is a clinical one. We began by attempting to correlate clinical and pathological and biochemical evidence and to classify accordingly, but the use of iodine as a therapeutic measure has become so prevalent that few of our patients reach hospital without having been subjected to a course, often prolonged, of iodine treatment. Moreover, practically all our patients with toxic symptoms are given Lugol's solution for ten days prior to operation. This so confuses the pathological evidence that we find it unreliable as an aid to classification.

We have reached the conclusion that an arbitrary division of thyreotoxic states into primary and secondary is with a large number of cases difficult to make, and serves no practical purpose; that the pathological changes which induce toxicity are the same whether they occur in a previously healthy gland or in a gland already diseased. We think that an eponymous designation is undesirable, and would abandon its use but for habit and convenience.

Our classification is as follows, but we recognize that any classification dealing with so labile and variable a structure as the thyreoid must necessarily be in our present knowledge only an approximation to accuracy:

1. Simple Goitre.
   - (*a*) Simple colloid.
   - (*b*) Simple nodular.
2. Thyreotoxic.
   - (*a*) Primary Graves's disease.
   - (*b*) Secondary Graves's disease.
3. Hypothyreoid states.
   - (*a*) Myxœdema.
   - (*b*) Cretinism.
4. Malignant thyreoid.

The number of cases in each group is shown in Table I.

It should be noted that a final analysis of the simple colloid and nodular cases would indicate that 25% and 33⅓% respectively might justifiably be placed in the toxic class, on the basis of a slight but definitely raised metabolic rate associated with strongly suggestive clinical features. This would swell the total of thyreotoxic cases very con-

siderably and would give, we believe, a truer picture of the incidence of toxicity.

TABLE I.

Type.	Males.	Females.	Total.
Simple Goitre:			
(*a*) Simple colloid	11	32	43
(*b*) Simple nodular	16	120	136
Thyreotoxic:			
(*a*) Primary Graves's disease	25	71	96
(*b*) Secondary Graves's disease; toxic nodular goitre	8	76	84
Hypothyreoid States:			
(*a*) Myxœdema	0	4	4
(*b*) Cretinism	0	0	0
Malignant Goitre	4	1	5
Grand Total			368

SIMPLE GOITRE.

Simple Colloid Goitre.

Forty-three cases fall into the simple colloid goitre group. The age and sex grouping is shown in Table II.

TABLE II.

Age Group.	Male.	Female.
Years.		
Under 10	1	—
10 and under 20	5	10
20 and under 30	6	10
30 and under 40	—	7
40 and under 50	—	3
50 and under 60	—	1
60 and under 70	—	—
Totals	12	31

Family History.

The family history was positive for goitre in 24 cases, and more than one member of the family was affected in 11.

Ætiology.

Twenty-three patients gave evidence of infection (teeth twelve, tonsils eight, various infections three), six alleged stress or worry, and

five dated the goitre from pregnancies or excessive child-bearing. Combined influences obtained frequently, and most patients came from endemic areas and their diet was notably deficient in iodine value.

Clinical Features.

In all, the goitre was of no more than moderate size, soft, diffuse and symmetrical. No nodules could be detected clinically, but we believe that the majority, if not all, long standing apparently colloid goitres are really nodular, though nodules may be difficult to detect.

Less than one-third of the patients complained specially of pressure, and the majority were sent to hospital because they complained of symptoms such as lassitude, nervousness, palpitation and breathlessness.

The pulse rate was raised ten beats on the average, and this, taken along with the above features and the slightly raised metabolic rate not infrequently observed, would indicate mild degrees of toxicity.

Eye Signs.

In every case we make careful search for the accepted eye signs, namely exophthalmos, lid-lag, widening of the palpebral fissure, stare, muscle weakness and palsy. We would refer to the sign credited to Kocher, that is, rapid retraction of the upper lid leaving the eyeball to follow more slowly when the eye is turned up from the lowered position, because it is often present when von Graefe's sign is absent. It may appropriately be termed "globe-lag" in contradistinction to "lid-lag" (von Graefe). We find that eye signs are not peculiar to toxic goitre (primary Graves's disease), but may be present in any variety. In this group seven showed definite eye signs, and they not with the more pronounced symptoms and with low metabolic rates.

Treatment.

Operation was performed in 22 cases for reasons of bulk, pressure or border-line toxicity or because symptoms persisted and the goitre was unchanged by medical treatment. The medical treatment of these cases we have found unsatisfactory. We have failed to achieve the results reported by Plummer with the use of thyroxin, using his technique and doses. We have used the British Drug House thyroxin tablets given by mouth, with no result over a limited trial.

Our usual practice is to insure that the diet supplied is rich in iodine by prescribing foods of high iodine value.

The field and experimental evidence in New Zealand so strongly supports the hypothesis that iodine deficiency is the principal ætiological factor in the production of goitre that particular attention has been directed to the patients' diet both before entering hospital and on discharge. In the great majority of the patients in this series the diet has been found to be poor in iodine-containing foodstuffs, and in some cases such gross deficiency has been revealed as to suggest that the

patient, even if resident in a district rich in iodine, would have tended to be in negative iodine balance. The neglect of sea-foods in general, and particularly in those known to be iodine-rich, was a striking feature in this insular country. The use of iodized salt was found to be erratic, and in the cases where its systematic use had been adopted it was the exception to find that it was being used for table and cooking purposes. Furthermore, it is impossible to appraise its prophylactic value, as in most cases it had been adopted as a therapeutic agent.

On discharge from hospital the patient is given dietetic instruction with a printed list of specific articles of diet recommended. The use of iodized salt for all domestic purposes is advised. The use of some seaweed preparation, such as "Irish Moss" (B.P.), is stressed, and recipes are given by which palatable soups and sweets can be prepared. Fishes shown to be iodine-rich are recommended, such as the kelp feeding *Coridodun pollus*, variously known popularly as green bone or kelp salmon, butter fish, shell fish of all kinds and other fishes which tend to feed on the iodine-rich plankton of the sea bottom. The value of milk, eggs and green vegetables is stressed, and, in the case of the latter item, the need in cooking for the retention of the vegetable water which contains most of the iodine, is pointed out.

Some of these patients were treated in this way only.

Where more active treatment is indicated, we give desiccated thyreoid in doses of 0·06 to 0·12 gramme (one to two grains) thrice daily together with fractional doses of potassium iodide. The thyreoid gland is rubbed with 1% *unguentum hydrargyri iodi rubri* once daily. With this treatment we have achieved only moderate success. In two cases Lugol's solution was tried in small doses, but without effect.

Two patients were made slightly toxic by a therapeutic error, 0·6 gramme (ten grains) of potassium iodide being prescribed thrice daily by mistake. The glands became firmer and smaller; stare, tremor, increased nervousness and increased pulse rate were induced.

We have had experience in private practice of toxicity induced in this class of goitre by potassium iodide in excess.

A young woman medical student on her own prescription took 0·6 gramme (ten grains) of potassium iodide thrice daily and small doses of thyreoid substance. She presented a typical picture of toxic diffuse goitre with pronounced eye signs, and was subsequently operated upon with complete success.

Two patients, a man and a woman, were treated by one of us for adiposity. As part of the treatment, each was given 0·6 gramme (ten grains) of potassium iodide thrice daily. In the course of a few weeks both developed tachycardia, tremor, eye signs and other symptoms of thyreotoxicosis. Rapid loss of weight revealed in each a diffuse symmetrical goitre which had been obscured by submental fat. The woman, after a prolonged illness, recovered under medical treatment. The man also recovered after two ligature operations and a partial thyreoidectomy, but his exophthalmos persists.

A proprietary preparation called "Tiadin", which contains iodine and which has some popularity among lay people for rheumatism, is occasionally responsible for precipitating toxic symptoms, particularly

in long standing nodular goitre. Two such cases came under our notice in one week.

When the use of iodized salt was first introduced as a prophylactic measure, the matron of a hostel for women students herself added potassium iodide to the salt in excessive amount. As an apparent consequence, four of the inmates who had had simple diffuse goitres for long periods consulted one of us with definite symptoms of thyreotoxicosis. These experiences suggest caution in prescribing potassium iodide in an endemic district. However, in the series under review, it is worthy of note that in no case was iodine responsible for the onset of toxicity.

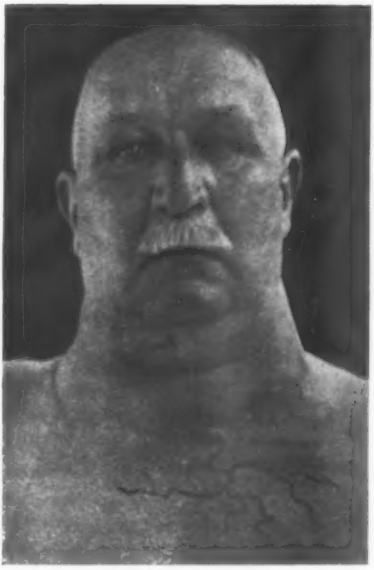

FIGURE IA. Simple colloid goitre.

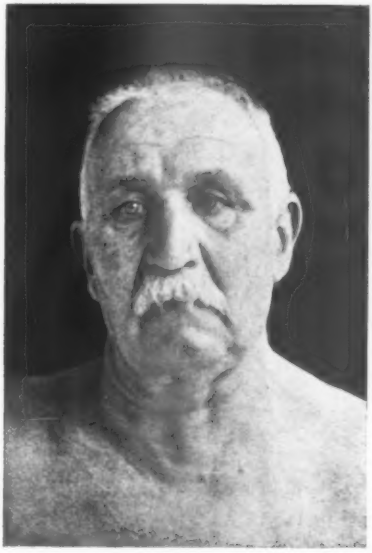

FIGURE IB. One month after teeth extraction for extreme sepsis.

Treatment of Septic Foci.—In colloid, as in other forms of non-malignant goitre septic foci should be searched for and receive appropriate treatment.

One colloid goitre causing severe pressure symptoms in an elderly man with appallingly septic teeth, disappeared in dramatic fashion after dental extraction and Lugol's solution, 0·36 mil (six minims) given thrice daily for one week (Figures IA and IB).

In toxic goitre, removal of septic foci is best left till after surgical treatment of the thyreoid itself.

Simple Nodular Goitre.

One hundred and thirty-six cases fall into the simple nodular goitre group. The age and sex grouping is shown in Table III.

TABLE III.

Age Group.	Male.	Female.
Years.		
Under 10	—	—
10 and under 20	2	6
20 and under 30	3	37
30 and under 40	3	37
40 and under 50	1	31
50 and under 60	1	8
60 and under 70	1	6
Totals	11	125

FIGURE IIA.

FIGURE IIB.

Simple nodular goitre, the largest observed in the series. (Weight of excised gland, 482 grammes.)

Family History.

The family history was positive for goitre in 87 cases, and more than one member (several times whole families) was affected in 51.

Ætiology.

Fifty patients gave evidence of infection (teeth 26, tonsils 13, various infections 11), 29 alleged stress and 18 child-bearing (14 children in one case and 13 in another). Combined influences were often active. The vast majority came from endemic areas. In the few cases of immigrants it is noteworthy that the onset of goitre is not infrequent within the first year of arrival in New Zealand.

Clinical Features.

The thyreoidal picture showed great variability in size, number and distribution of the nodules (Figures IIA, IIB, and III), but multiplicity and irregularity were the rule and the isolated nodule rare. A sixth of the cases showed no subjective or objective symptoms, the patients desiring operation for cosmetic reasons, or because some acquaintance had undergone operation for reasons of toxæmia or pressure, and so had raised the alarm. Rather more than 50% showed pressure symptoms of very variable degree. It may be observed in this connexion that a complaint of a feeling of tightness or constriction in the neck should be regarded always as extremely suggestive of genuine pressure by a nodule, and operation should not be lightly refused even when the goitre is small and nodularity is only dubiously detectable. Operation in these commonly reveals more evidence of pressure than the clinical examination afforded. We have found X ray examination in this type to be unreliable, though it affords additional confirmation in the grosser forms of tracheal compression or displacement.

FIGURE III. Simple nodular goitre in girl of seventeen years.

At this point we may refer shortly to retrosternal goitre, because one of our cases presents certain puzzling features.

This was in a woman of forty with a large generalized nodular goitre exhibiting both pressure and mildly toxic symptoms, and showing dilated and tortuous veins over the sternum. X ray films showed a large retrosternal shadow and lateral displacement of the trachea in the neck. At operation the lower poles were found to extend a short distance behind sternum and clavicles, but no thyreoidal extension corresponding to the skiagram could be located on

careful search. Seen this week, four years after operation, she is perfectly well, though the dilated veins persist. A skiagram (Figure IV) shows the retrosternal shadow exactly as it was before operation, but the cervical tracheal displacement has disappeared. The precise nature of the shadow remains uncertain, but we believe it to be due to an aberrant thyreoid.

As has already been noted, fully 30% might with justification be placed in the toxic class, and these patients came for treatment because

FIGURE IV. Skiagram, showing retrosternal shadow four years after operation. Patient entirely symptomless.

of mildly toxic symptoms. The pulse rate was raised ten beats on the average. Eye signs were present in thirty-five cases (approximately 25%).

Treatment.

One hundred and twenty patients were submitted to operation with one death (pulmonary embolism) and excellent results.

In certain symptomless nodular goitres the possibility of subsequent neoplastic development has decided for operation.

THYREOTOXIC GOITRE.

Primary Graves's Disease.

Ninety-six cases fall into the primary Graves's disease group. The age and sex grouping is shown in Table IV.

TABLE IV.

Age Group.	Male.	Female.
Years.		
Under 10	—	—
10 and under 20	3	6
20 and under 30	5	15
30 and under 40	4	25
40 and under 50	6	18
50 and under 60	4	4
60 and under 70	3	3
Totals	25	71

Family History.

The family history was positive for goitre in 36 cases, more than one member of the family being affected in 14. In several a family history of toxic goitre was noted. On one occasion a mother and son underwent operation for Graves's disease the same week. This proportion (36 in 96 cases) is much smaller than occurs with the simple colloid and nodular goitres and the toxic nodular group, where the proportion is noticeably more than half of the total cases.

Ætiology.

Thirty-one patients gave evidence of infection (teeth 15, tonsils seven, various infections nine). Thirty-seven alleged stress and only four child-bearing. Combined influences were often present.

Clinical Features.

Though it was formerly the impression of those of us who have had experience of Graves's disease in Great Britain that the condition was of greater severity than in this endemic country of New Zealand, a careful review of our cases leads us to revise our opinion in some degree. Few of our patients escape iodine medication in some form before admission to hospital, with consequent modification of the clinical picture. The higher mortality in toxic goitre reported by certain observers in Great Britain, for example Wallace and Wevill[2] in Edinburgh, would give colour to the idea that their cases are more severe: a greater mortality, however, may be related to the observation of stricter criteria in admitting patients into the toxic class.

Our cases are typified by an incapacity for work on account of general nervousness, heart consciousness and muscular weakness, one or other or all of the peculiar eye signs, a history of contemporaneous appearance of symptoms and moderate thyreoid enlargement (Figures VA and VB), the pulse rate averages 100, the basal metabolic rate is rather less than +50, and in most cases there is a disturbance of carbohydrate tolerance.

The graver manifestations, for example circulatory and nervous crises and rapid wasting, are not so rare as we formerly believed, but are probably relatively fewer than in some other countries.

FIGURE VA.

FIGURE VB.

Primary Graves's disease in patient of twenty-eight years, with three months' history.

Eye signs were present in all but nine cases, but were relatively slight, and only three showed exophthalmos in pronounced degree (Figure VI). Ulceration of the cornea occurred in two, and such accidents as dislocation of the eyeball, and such procedures as suturing the lids to prevent dislocation, are outside our experience.

The following case history illustrates primary Graves's disease as we commonly see it.

CASE I (No. 31/2908).—A female patient, aged thirty years, married, was admitted to hospital on October 29, 1930. She came from the endemic area of Otago. The family history showed that the mother had a goitre for forty years. According to the patient's previous history, she had always been healthy.

The diet had been poor in iodine value. It had contained little milk or cream and no brown or wholemeal bread. Plenty of green vegetables had been taken, but no use had been made of the water in which they were boiled. She had taken little fish, and no shellfish. The drinking water was rain water. She had been using iodized salt for table and cooking for six months prior to admission to hospital.

Her present illness began nine months before admission; for no apparent reason she became irritable, nervous, breathless, heart-conscious and lost weight. Nine weeks before her admission to hospital she noticed a goitre for the first time. It appeared suddenly.

FIGURE VI. Recurrent Graves's disease (operation twelve years previously) in a woman of forty-six years, with marked proptosis and corneal ulceration, the worst in the series.

On admission her weight was 53·5 kilograms (eight stone seven pounds). Marked stare and a slight von Graefe sign were present. A moderate, generalized, firm enlargement of the thyreoid, with pulsation, thrill and murmur, was found. The skin was moist; flushing and heat intolerance were noted. The patient was nervous, restless, irritable, emotional and complained of palpitation and shortness of breath. Tremor of fingers and tongue was present. The pulse rate was 120 to 140; it was regular. The systolic blood pressure was 140, and the diastolic pressure was 70 millimetres of mercury. The pulse pressure was 70 millimetres. The heart was slightly enlarged. All the deep reflexes were exaggerated. The urine was normal. The basal metabolic rate was + 80.

Absolute rest in bed was ordered with a high caloric diet. Bromides were given. Lugol's solution 0·6 mil (ten minims) was given thrice daily from the fifth day after admission. Already, with the institution of rest and quiet, the patient had become more composed and the basal metabolic rate had fallen, but a marked subjective improvement ensued upon the administration of Lugol's solution and the metabolic rate continued to fall. Three weeks after admission the patient was regarded as fit for operation, and partial thyreoidectomy was performed and the reaction to operation was slight. The patient made an uninterrupted recovery, and was discharged eighteen days after operation.

The pathology report was that the thyreoid weighed 35 grammes. Sections showed typical hyperplastic diffuse goitre with evidence of reversion to colloid state due to iodine. It is primary Graves's disease.

Two acutely toxic and fatal cases in which the patients were never well enough for operation, may be detailed to indicate examples of extreme severity; one was complicated by acute tuberculosis.

CASE II.—The patient was a female, aged forty years, a housewife. The family history contained no history of goitre. The mother died of diabetes.

According to the past history, the patient had an attack of acute Graves's disease after child-bearing thirteen years ago. The patient was treated medically. Another attack occurred also after child-bearing three years ago.

The history of the present illness was that the patient had been confined four months ago. She had been very nervous since. After weaning the baby five weeks ago, exophthalmos and goitre appeared, together with tachycardia, tremor, vomiting, diarrhœa, palpitation, extreme nervousness, restlessness and irritability. She was treated at home by Lugol's solution, 0·3 mil (five minims), thrice daily, with subjective improvement.

On admission to hospital the patient was well nourished, but was losing weight rapidly. She was extremely nervous and apprehensive, and showed peculiar restlessness. The pulse rate was 128. The basal metabolic rate was +127. The systolic blood pressure was 130 and the diastolic pressure 80 millimetres of mercury. The pulse pressure was 50 millimetres. The heart was enlarged (teleradiograph). Exophthalmos and von Graefe's sign were present. There was a moderate, firm, generalized enlargement of the thyreoid, with pulsation, thrill and murmur. Tremor of the fingers and tongue was present, with sweating, flushing, heat intolerance. The glucose tolerance test gave a hyperglycæmic curve with a trace of sugar in the urine at the highest point of the curve. The patient's temperature was 37·8° C. (100° F.) on admission. Thereafter she was apyrexial until towards the close, when the temperature varied between 37·2° and 37·8° C. (99° and 100° F.) for two or three days.

A diagnosis of recurrent primary Graves's disease was made.

Treatment consisted in absolute rest in bed. Bromides and Lugol's solution, 0·6 mil (ten minims), were given thrice daily. One application of X rays was given, but the patient was so upset that it was not repeated.

Five weeks later the basal metabolic rate had fallen to +67 and the pulse rate to 100. It was decided to ligate one superior thyreoid artery, as the patient was in no condition for other surgical procedure. She was transferred to a surgical ward, and even this change of environment, with its associations, was enough to precipitate a circulatory crisis. The pulse rate rose to 136, she became extremely restless, delirious, throwing herself about, and died of exhaustion two days later.

Possibly in this case too early a resort to surgery was made and perhaps the dose of iodine was insufficient.

CASE III.—The patient was a female, aged fifteen years. Her occupation was domestic duties. She was admitted to hospital on July 16, 1928.

According to the family history an aunt died after an operation for goitre. There was a strong history of pulmonary tuberculosis.

The patient's previous illnesses included mumps, measles and scarlet fever.

The history of the present illness was that the patient had a goitre for two years, which had increased in size during the last month. The symptoms began in January with headache, abdominal pain, general debility, occasional vomiting, loss of weight, tremor, nervousness, muscular weakness, palpitation and tachycardia. Amenorrhœa had been present during the last three months, and weakness, loss of weight and vomiting had been more pronounced.

On admission to hospital the patient weighed 44·1 kilograms (seven stone). She was pale, undernourished, restless and nervous. Marked eye signs were present. There was a moderate, generalized, firm enlargement of the thyreoid, with pulsation, thrill and murmur. The pulse rate was 120. The patient's temperature was normal. The systolic blood pressure was 130 and the diastolic pressure was 50 millimetres of mercury. The pulse pressure was 80 millimetres. The basal metabolic rate was +48. The glucose tolerance curve was normal. There were physical signs of an active tuberculous lesion in the upper part of the left lung; this was confirmed by radiography. From the outset difficulty was

experienced in nourishing and treating this patient, on account of the disposition to vomit. Vomiting at times became critical, and she died in the course of a gastric crisis on September 28. Lugol's solution was administered in doses ranging from 0·18 to 2·0 mils (three to thirty minims) thrice daily. As an alternative, tincture of iodine in drop doses at short intervals was tried, but without effect. Three applications of X rays were given. The patient's general toxic condition and state of inanition, complicated as it was by an active pulmonary lesion, made operation inadvisable. None of the means of treatment employed produced appreciable benefit.

Cases Presenting Difficulty in Diagnosis.

Cases presenting difficulty in diagnosis are chiefly those of psychasthenia, anxiety-neurosis or hysteria, but several have been retained in this group, probably without justification.

The following case report illustrates our difficulty:

CASE IV.—The patient was a male, aged thirty years, single, a bank clerk. He was admitted to hospital on November 22, 1930.

The family history was of no importance. There had been no previous illnesses.

The history of the present illness was that for two or three years the patient had had palpitation at intervals. During the week before admission this became frequent and pronounced, and was associated with nervousness, irritability, weight loss and insomnia. Three days before admission he collapsed in the street and again in his office.

On his admission to hospital there was a moderate, generalized, firm, homogeneous enlargement of the thyreoid gland. Slight proptosis, von Graefe's sign and widening of the palpebral fissure were present. There was a coarse tremor of hands, arms, face and tongue. The hands were dry. The patient was nervous, anxious and sleepless. He had lost 4·5 kilograms (ten pounds) in a month. The pulse rate was 60. The systolic blood pressure was 130, and the diastolic pressure was 90 millimetres of mercury. The pulse pressure was 40 millimetres. The basal metabolic rate was −9.

Treatment consisted in absolute rest in bed, a high caloric diet and the administration of quinine hydrobromide, with no apparent benefit. No Lugol's solution was given. The patient was discharged at his own request sixteen days after admission.

After a month's holiday, with some subjective improvement, he resumed work, but his symptoms persisted, the tremor being so pronounced that he had been unable to do his work.

On the patient's readmission to hospital his basal metabolic rate was −1. His pulse rate was 60. Partial thyreoidectomy was performed with only a slight reaction. Sections of thyreoid showed it to be of the resting colloid type with no present evidence of hyperplasia.

Except for generalized enlargement of the thyreoid gland and the very definite eye signs, this man did not present the picture of primary Graves's disease. The tremor was too coarse and generalized, the nervous symptoms more those of an anxiety-neurosis, the pulse was slow, his hands were dry, and the metabolic rate was low.

Difficulty in precise diagnosis may arise from the fact that a cardinal feature of the disease may be absent and the clinical picture anomalous in one or more important respects.

In one of our patients, who presented the ordinary features of Graves's disease, no thyreoidal enlargement could be felt, and at operation a tiny gland was exposed and resected, only a shell of thyreoid tissue being left. Microscopically it was of the active hyperplastic type.

The patient improved and went back to work, but reported a year or more later acutely ill with a greatly enlarged gland of typical hyperplastic character, but much bigger than commonly seen. Lobectomy was performed in two stages, and after a prolonged and difficult convalescence he is well enough to carry on his work.

The remarkable contrast between the tiny impalpable gland seen at the first operation and the relatively huge hyperplastic gland seen later, afforded striking evidence of the capacity of a hyperplastic thyreoid to undergo a wide variation. This capacity for regeneration and overgrowth no doubt explains some, at least, of the occasional disappointing results after adequate resection for hyperplastic goitre.

Another patient seen in private practice had all the classical features of severe Graves's disease, except a palpable thyreoid and rapid pulse. In fact, the pulse rate in this case never rose above 80, and was usually about 70, and this, with the absence of a palpable goitre, made us chary of proceeding to operation, though all the other features clamoured for it. He made no satisfactory progress under prolonged medical treatment, and at operation a small hyperplastic gland was found. The resection was made so radical as to invite myxœdema deliberately, and the patient has done extremely well.

In the remaining cases of difficulty the symptomatology was anomalous, and there was no response to treatment. These patients with psychasthenia or anxiety-neurosis, as we see them, show predominantly nervous symptoms and usually eye signs, along with an enlarged thyreoid and a low metabolic rate. They should be excluded rigorously from operation, as they invariably do badly.

Treatment.

Eighty-seven of the 96 patients were submitted to operation with a mortality of 4·6%.

Results of Treatment.—We do not present a percentage table indicating cure, improvement *et cetera*, but would record our favourable general impression of the results of partial thyreoidectomy for Graves's disease as seen in the follow-up clinic. Many cases are most gratifying, and few patients who properly fall into the category of true toxic goitre are not benefited to some useful degree. Occasional failures may be traced to inadequate resection of thyreoid tissue, or to overgrowth of the fragments left, or to economic stress forcing the hospital class of patient back to work too soon. Total failure, in our experience, has been due to faulty selection and bad judgment in not excluding the psychasthenia, anxiety-neurosis type of patient from operation.

Recurrences, however, may be both puzzling and disconcerting in those cases in which adequate resection has been performed and proper supervision maintained thereafter.

We have in the hospital at present a man of thirty-five years, who, seven years ago, suffered from severe Graves's disease and made a good recovery after ligation of vessels and subsequent thyreoidectomy. He

kept well and did full farm work till recently, and now presents the picture of advanced Graves's disease with a greatly enlarged gland.

Reference was made to a similar case in the previous section where a large recurrent gland developed. Cases of this type give colour to the view that, however successful thyreoidectomy may be in Graves's disease, it simply breaks a link in the chain of the vicious circle in the majority, while in a minority the unknown stimulus continues to act or flares up after an interval and recurrence of goitre and of symptoms follows.

Secondary Graves's Disease.

Eighty-four cases fall into the secondary Graves's disease group. The age and sex grouping is shown in Table V.

TABLE V.

Age Group.	Male.	Female.
Years.		
Under 10	—	—
10 and under 20	—	1
20 and under 30	2	10
30 and under 40	—	24
40 and under 50	2	20
50 and under 60	4	15
60 and under 70	—	6
Totals	8	76

Family History.

The family history was positive for goitre in 48 cases, more than one member being affected in 20. In several a family history of toxic goitre was noted.

Ætiology.

Twenty-five patients gave evidence of infection (teeth eleven, tonsils six, various infections eight), 35 alleged stress and eight child-bearing. Combined influences were often acting.

Clinical Features.

Reference has already been made to the difficulty of differentiating toxic diffuse and toxic nodular goitre, and it may not be out of place to recapitulate some of the more important criteria which have guided us in admitting cases into the toxic nodular group. These are: (i) the presence of a nodular goitre, (ii) a history of goitre having been present for some years without producing toxic symptoms, (iii) the presence of the Graves syndrome. The group includes some of our severest cases of toxic goitre, and the clinical picture, except for the nodular character and long duration of the goitre, was in these indistinguishable from primary Graves's disease. In general, circulatory disturbance is more

evident, auricular fibrillation slightly more frequent and congestive heart failure more striking in the secondary class.

Eye signs were present in 75% of cases, but, except in one or two, were not so pronounced as in the primary group (Figures VIIA and VIIB).

Pressure symptoms were often present, but were overshadowed by the toxic.

Treatment.

Seventy-four patients were submitted to operation with a mortality of 2·7%.

Results.—The follow-up indicates rather better and more permanent benefits after operation than in the primary cases.

We propose to consider the two groups of toxic goitre as one under the headings of mortality, circulatory disturbance, the use of Lugol's solution and of radiotherapy.

Mortality in Toxic Goitre.

The operative and non-operative deaths in the 180 cases are shown in Table VI.

We have endeavoured to analyse the deaths in both classes.

TABLE VI.

Total Cases.	Submitted to Operation.	Operative Death.	Non-operative Death.
180	161	6 (3·7%)	5 (2·7%)

Operative Deaths.—Three deaths appeared to be due to faulty technique or to special difficulty at operation, and hæmorrhage played the chief lethal part. One patient died four days after operation with suggestive features of coronary or pulmonary infarction. Another had had labour induced for eclampsia three to four months previously, and the sixth had been considerably upset by dental extraction some weeks before operation.

Non-Operative Deaths.—More efficient use of Lugol's solution and glucose might possibly have saved some patients. One patient died because we under-estimated her toxæmia and transferred her mistakenly to a surgical ward for operation and precipitated a crisis. One was complicated by active pulmonary tuberculosis.

The Heart in Toxic Goitre.

We are unable to offer any useful comment on enlargement of the heart in our 180 cases of toxic goitre, as we failed to submit the earlier cases of teleradiography.

The average pulse rate was 100, the highest was 144, the lowest 70.

The pulse pressure was raised on the average 15 to 20 millimetres above normal; though this feature is suggestive of toxicity, it is by no means diagnostic, as some of our worst cases showed no elevation.

Auricular fibrillation occurred in thirteen cases before operation, and transient fibrillation was observed in a number of patients after operation, particularly among those in the older age groups. Our experience agrees with that of other observers, that fibrillation prior to operation is not amenable to drug treatment, but usually disappears after operation spontaneously, or can then be abolished by the exhibition of quinidine or digitalis; in other words, until the toxic focus has been eliminated the arrhythmia persists.

In patients with congestive heart failure the response to operation has been gratifying.

The Use of Lugol's Solution.

Lugol's solution has been employed in both forms of toxic goitre as one of the preparatory measures for operation, and though we have not observed the dramatic effects reported by some, it has been of great use. We believe its beneficial effects are most obvious in the diffuse hyperplastic cases (primary Graves's disease), but many of the nodular variety (toxic adenoma of Plummer) also respond, though not usually to the same degree. Our practice is to give the solution for some seven to ten days before operation in doses of 0·3 mil (five minims), rapidly worked up to 0·6 mil (ten minims), thrice daily, though in the nodular variety it is wise to commence with a tentative small dosage for several days, as occasional cases are made worse by iodine administration.

We would insist that the proper use of Lugol's solution is in preparation for operation and given only for a short period. We are handicapped both in precise diagnosis and treatment by the rapidly growing habit among practitioners of employing Lugol's solution as a treatment and administering it over long periods, a tendency also noted in other quarters.

On the day of operation, the amount given is increased and 3·0 to 3·6 mils (50 to 60 minims) are administered over the twenty-four hours. Thereafter the dosage is kept at about 1·8 mils (30 minims) for three to four days, and then tailed off till when the patient is ready to leave hospital it is down to 0·12 to 0·18 mil (two to three minims) twice daily. For about two months after discharge the patient is instructed to take 0·12 mil (two minims) twice daily, and this is gradually cut down in frequency till towards the end of the period it is taken once or twice a week. For some time we stopped the use of iodine after discharge, but have reverted to the practice outlined broadly above.

All who have to do with the operative treatment of toxic goitre, especially of the primary Graves type, will testify to the value of iodine, and operation is undertaken with greater confidence and followed by infinitely less anxiety than in the pre-iodine days. In fact, very few patients in our experience exhibit any serious upset, and the gravely disturbing reaction is almost abolished.

Radiotherapy in Goitre.

Apart from the malignant group, radiotherapy, usually in the form of a course of medium X rays spread over many months, or rarely in the shape of a radium pack, has been employed in selected cases of toxic goitre. These fall into four categories:

1. Bad risks as a method of preparation for operation. The results here have been frankly disappointing; indeed, the impression has been gained that the condition may be aggravated by such treatment.

FIGURE VIIA. Secondary Graves's disease in a patient of forty-eight years: eight years' history of goitre, recent toxic symptoms.

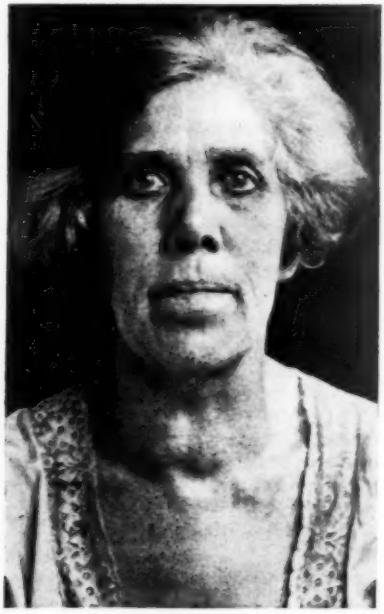

FIGURE VIIB. Secondary Graves's disease in patient of sixty years: thirty years' history of goitre, recent toxic symptoms. Both illustrate the close ocular similarities to those of primary Graves's disease.

2. Patients refusing operation, though suitable for it. We can record one gratifying result following X ray treatment spread over fifteen months.

3. Doubtful cases which appear to combine the features of toxic goitre and psychasthenia. In these, resort to X rays may be regarded as partly diagnostic and partly therapeutic in aim. Some patients appear to be benefited, may sleep and eat better and put on weight, but in general these beneficial effects are transient.

4. Recurrences after operation, especially in diffuse hyperplastic goitre. Here the results in a small group have been distinctly encouraging, and it may be that this class, both disappointing and anxious for the surgeon, offers a promising field to the radiotherapeutist.

MALIGNANT DISEASE OF THE THYREOID.

Five cases of malignant disease of the thyreoid have come under observation in the clinic. This incidence may be considered small in relation to the series, and it may be questioned whether it gives a true picture of malignant disease in this field.

The following table, taken from the New Zealand Government Report on Vital Statistics, 1932, indicates its relative infrequency:

Deaths from Cancer of the Thyreoid in New Zealand, 1927-1932.

	Males.	Females.
1927	3	3
1928	2	3
1929	2	7
1930	4	5
1931	6	6
1932	3	7

It is possible that the more frequent resort to operation in earlier stages in the history of a goitre eliminates some malignant adenomata in their infancy, so to speak, and it is possible also that a more searching microscopic examination of nodular goitres might reveal an unexpected malignant adenoma here and there.

Our cases are so few in number and so varied in character as to require only a passing mention. One, in a young woman, already showed numerous metastases in bone, especially the skull, when first seen. Another, in an elderly man who had had long standing goitre, rapidly progressed to a fatal issue despite radiotherapy. A third, a large malignant adenoma in an elderly woman with long standing goitre, was suspected before operation, and the whole of the affected lobe was removed. The patient is alive ten months later, but in feeble health.

We have consequently had little opportunity of forming any conclusions in regard to the question of operation and radiotherapy.

Bearing on the tendency of malignant goitre to form secondary deposits in bone, three of the five cases showed osseous metastases.

HYPOTHYREOID STATES.

For the sake of completeness we refer briefly to hypothyreoid states. Post-operative hypothyreoidism is mentioned in another section.

No case of cretinism has come under the notice of the clinic.

Four cases of fully developed myxœdema were observed during the period; cases exhibiting minor manifestations of possibly subthyreoidal nature appear from time to time, but these are not included.

OPERATIVE PROCEDURES.

Anæsthesia.

Gas and oxygen have proved so eminently satisfactory that this combination has come to be used almost exclusively, alone or combined with local "Novocain" infiltration of the superficial layers, according to the surgeon's taste. Preceded by "Nembutal" or "Luminal", we consider it ideal for goitre cases.

Type of Operation.

(*a*) *The Simple Cases.*—The precise type of operation varied with the needs of the case. The isolated single adenoma or cyst, lending itself to simple enucleation or enucleation, resection was rarely met with, and in the majority the pathological changes were so diffuse as to necessitate a bilateral resection generally with removal of the isthmus. It is often hard to find a reasonably healthy portion of thyreoid substance to leave. In the cases exhibiting pressure symptoms special attention is given to a complete examination of the gland, so that outlying nodules should not be overlooked, especially at the back of the lobe burrowing towards and behind the trachea, and at the lower pole. In those cases suffering from pressure and with a low metabolic rate, care should be taken to leave a maximum of healthy gland.

(*b*) *The Toxic Cases.*—The secondary Graves type with nodular goitre was treated on the above lines, the vast majority requiring some form of double resection, a single adenoma being rarely observed.

The primary Graves type with diffuse hyperplastic goitre, with few exceptions, was submitted to double lobectomy with removal of the isthmus in one stage, leaving a fragment of thyreoid substance along the postero-internal border over the site of the recurrent laryngeal nerve. It is difficult to estimate fractionally how much of the gland is taken away, and it serves a far more useful purpose to consider the resection not in terms of how much is removed, but how much is left. Adequate resection is the keynote of success, even if the risk of myxœdema is incurred.

In general, the extensive complete bilateral resections were well borne and attended with no harassingly serious reactions, but the committee recognizes the important fact that the toxic cases dealt with over the period were in the main only of moderate severity, and would emphasize the necessity in bad cases where it is so difficult to assess the risk, and the likely mistake is to attempt too much, of proceeding with great care and of adopting the stage method when in doubt. Consequently, it is better to complete the operation on one side, leaving the other lobe absolutely undisturbed to minimize adhesions on that side, if after consultation with the anæsthetist and a consideration of pulse rate, blood pressure and so on, it be deemed advisable to defer operation on the other lobe for a subsequent occasion.

In our experience, the stage method is rarely required, but occasionally may be of extreme value.

Ligation of the superior thyreoid vessels was adopted in several bad risks, though, as has been found elsewhere, the preliminary use of Lugol's solution has largely eliminated this form of attack. If ligation is restricted to grave risks, the mortality obviously is likely to be higher than for lobectomies. In one gravely ill patient ligation of the superior thyreoid vessels was performed on one side under local anæsthesia with a rapidly fatal result. Another of the same type survived ligation of the superior vessels at different times, but showed little benefit and succumbed rapidly after a single lobectomy some months later.

Though it is superfluous to discuss the technique of thyreoidectomy in general, reference may usefully be made to operative procedures in two classes of case, which, though not uncommon up to the present, should become rare in the future:

1. The patient who has undergone previous operation for goitre and who has been left with a paralysed cord and who requires a further operation which may involve the sound cord. Such patients have usually been treated a good many years ago by a complete single lobectomy involving destruction of the recurrent nerve on that side, and come for operation a second time because of persistent toxic symptoms from the enlarged remaining lobe, or because of marked tracheal displacement from pressure. It has fallen to the lot of one of us to operate on a number of these cases, and it is certainly an anxious one.

2. The patient of the primary Graves type who requires further operation for recrudescence of toxic symptoms after a double lobectomy.

The essential principles of operation are the same in each, though the state of the thyreoid may differ greatly. All secondary operations for goitre are likely to be difficult, and the anxiety of the surgeon centres on the necessity for adequate resection of thyreoid tissue with due regard to the safety of the recurrent nerves or the solitary active nerve as the case may be. The path to safety lies before any attempt at resection is made in adequate exposure: by free transverse division of the infrahyoid muscles, and notching of the sterno-mastoid muscle if required; by careful stripping of adherent muscle off the lobe in all directions till the trachea and carotid packet are exposed on either side and the upper and lower limits of the thyreoid tissue are defined. Then and then only should the lobe or its remnant be "picked out", the postero-mesial border being left as little disturbed as is technically possible.

Complications Following Operation.

Recurrent Laryngeal Nerve Lesions.

Following the usual practice, patients are examined by the laryngologist before operation and again before leaving hospital, irrespective of whether any suggestive alteration in the voice be present. The importance of pre-operative examination is emphasized by the fact that in 115 simple nodular goitres some degree of unilateral paralysis was discovered in five cases. According to Judd,[3] recurrent nerve paralysis caused by goitre occurs in about 5% of cases, while Joll[4] states that

pre-operative palsies were observed in seven out of one hundred consecutive cases (excluding malignant and inflammatory types).

Where a previous operation for goitre has occurred, examination of the cords is of extreme importance, as the voice may give no clue whatsoever to an existing unilateral paralysis. To be forewarned is to be forearmed in these cases, and the necessary further operation can be planned and executed with particular delicacy; otherwise one courts the disaster of a double abductor paralysis.

Our experience may be tabulated as in Table VI.

TABLE VI.

Type of Goitre.	Number of Cases Examined.	Pre-operative Palsy.	Post-operative Palsy.
Simple colloid	20	2	0
Simple nodular	115	5	6
Toxic diffuse	78	2 (associated with operation years before)	4
Toxic nodular	79	2	5 (2 very slight)
Malignant	5	4 (1 bilateral)	

Excluding the malignant group in which nerve lesions are so common as to be almost the rule, scrutiny of this table tells us, as might be expected, that nodular goitre, be it simple or toxic, is the form most likely to cause spontaneous damage to the recurrent nerve or to be associated with injury to it at operation: in the one case because of persistent pressure, and in the other because the operator may require to exert considerable force or traction in dislodging larger posteriorly lying nodules to the capsule of which the nerve may be adherent.

The incidence of post-operative lesion is disquieting, though a number have been slight and transient, suggesting pressure, œdema or stretching as the cause. We have observed one case of bilateral abductor palsy in a patient who recovered in the course of two to three months after operation. Another patient with a long previously paralysed right cord required tracheotomy on the night of her operation for increasing stridor due to paralysis of the left cord, which has since rapidly improved to such an extent that it is not necessary for her to continue using the tube.

It is certainly salutary to review these nerve lesions from time to time, as it may well lead to a revision of technique and the elimination of too forcible handling.

Tetany.

For long we were disposed to consider tetany in relation to the operative treatment of goitre to be rather of mythical interest, but

during the past year three cases occurred, two of them within a fortnight. One was mild and two moderately severe, and all three responded promptly to treatment with calcium. These cases occur so rarely as to come as a shock, and though more likely to follow radical extirpation, are not restricted to this type. Parathyreoid bodies may be readily demonstrated in one case and indistinguishable in the next. A delayed onset of tetany suggests disturbance from œdema rather than ablation, and a careful search of thyreoid tissues for parathyreoids after operation bears this out.

Joint Complications in Relation to Thyreoidectomy.

We mention rheumatoid arthritis as a complication following operation because one middle-aged patient with toxic nodular goitre developed a severe and crippling polyarthritis while convalescing in the ward after successful operation. Furthermore, the complaint of joint troubles is not uncommon in patients showing post-operative myxœdema.

These experiences, limited as they are, would seem to run contrary to those reported by Duncan,[5] who describes cases of rheumatoid arthritis associated with hyperthyreoidism cured or greatly benefited by thyreoidectomy.

Post-Operative Hypothyreoid States.

Myxœdema.

Operation in the various classes of goitre has been responsible for the onset of myxœdema in rare instances. Radical thyreoidectomy in Graves's disease is inevitably followed by myxœdema in an indefinite percentage, indefinite because the minor degrees of thyreoid insufficiency are hard to assess: but a controllable myxœdema is vastly preferable to secondary operations for imperfectly relieved hyperthyreoidism. It is surprising what a small amount of thyreoid tissue may maintain the balance of health.

One elderly woman, who had many years before undergone a thyreoidectomy, presented herself with a small suspiciously hard nodule on the side of the thyreoid cartilage. This was removed to eliminate the possibility of cancer, and proved to be a small cyst about the size of a cherry. She reported in three months, presenting a full-blown picture of myxœdema.

In two cases œdema of the eyelids and of the conjunctiva appeared within six months of thyreoidectomy, though no other evidence of hypothyreoidism was evident.

BIOLOGICAL CHEMISTRY.

During the first two years of the study a number of iodine balance experiments were carried out on patients from each group. A diet of known iodine content (50 microgrammes) was administered, and after a week the iodine level of the venous blood and the iodine excretion by

urine and fæces were determined. The effect of the administration of 250,000 microgrammes (30 minims) of Lugol's solution was then studied. The detailed results will not be presented in this article, but one typical example from each group is given in Table VII.

The iodine content of blood, though remarkably constant for the same individual, shows definite variations according to district and season. In a series of specimens examined from the goitre-free Island of Samoa the iodine content of the blood was found to average 140

TABLE VII.

Group.	Pre-Lugol Findings.		
	Iodine Content of Blood. (Micro-grammes per Kilogram.)	Iodine Excreted in Urine. (Micro-grammes per 24 Hours.)	Iodine Excreted in Fæces. (Micro-grammes per 24 Hours.)
Simple colloid	87	19	4
Simple nodular	83	20	13
Primary Graves's	171	45	35
Secondary Graves's	125	29	20

Group.	Post-Lugol Findings.					
	After 24 Hours.			After 48 Hours.		
	Iodine Content of Blood. (Micro-grammes per Kilo-gram.)	Iodine Excreted in Urine. (Micro-grammes per 24 Hours.)	Iodine Excreted in Fæces. (Micro-grammes per 24 Hours.)	Iodine Content of Blood. (Micro-grammes per Kilo-gram.)	Iodine Excreted in Urine. (Micro-grammes per 24 Hours.)	Iodine Excreted in Fæces. (Micro-grammes per 24 Hours.)
Simple colloid ..	—	More than 100,000	500	405	319	212
Simple nodular ..	—	More than 100,000	350	328	199	43
Primary Graves's ..	—	More than 100,000	410	876	54	77
Secondary Graves's	—	More than 100,000	360	246	423	49

microgrammes per kilogram and, if this figure is taken as the normal for a district free from goitre, it will be seen that the iodine level of the blood is low in the non-toxic goitres and relatively high in primary Graves's disease.

In two cases of hypothyreoidism reported in this series the level of the blood iodine was 57 and 53 microgrammes per kilogram.

The iodine excretion in urine and fæces is notably lower in goitre endemic areas than in non-endemic areas, and the figures in Table VII accord with these findings. The level of excretion is on a definitely

higher level in primary Graves's disease where the functional activity of the thyreoid gland is greater. The introduction of 1·8 mils (30 minims) of Lugol's solution is reflected in the twenty-four hour excretion in urine and fæces, the kidney obviously excreting more than the bowel. Unfortunately, no figures are available in this series for the twenty-four hour blood findings. After forty-eight hours, however, the iodine level of the blood shows a marked increase in all groups, and the excretory figures, though much lower than in the twenty-four hour findings, remain elevated. It will be noted that iodine retention is more marked in primary Graves's disease.

The weight of the gland removed at operation is recorded in each case and the iodine content of the gland determined in selected cases. In some of the nodular specimens a comparison of the iodine content of the nodule and the adjacent normal gland has been carried out, and where

TABLE VIII.

Iodine Content of Thyreoid.
(Milligrammes per Gramme.)

Group.	Weight of Dried Gland Removed (in Grammes).	Non-Nodular Thyreoid Tissue.	Nodules.		
			Colloid.	Gelatinous.	Hæmorrhagic
Simple colloid (no iodine treatment)	301	0·06	—	—	—
Simple nodular (no iodine treatment)	225	0·14	0·14	0·02	0·009
Simple nodular (after iodine treatment)	300	2·18	2·12	—	—
Primary Graves's (after iodine treatment)	145	1·14	—	—	—
Secondary Graves's (no iodine treatment)	165	0·27	0·25	0·01	0·002
Secondary Graves's (after iodine treatment)	110	1·23	1·20	0·25	—

nodules of different types occur in the same gland each nodule has been studied separately. In selected cases the biochemical value of the specimen has been tested by tadpole metamorphosis experiment. Typical findings are given in Table VIII.

The normal iodine content of the thyreoid gland is approximately one milligramme per gramme (dried weight). It will be seen that in patients who have received no iodine medication in the non-toxic goitres and in the secondary Graves's group, the iodine content per gramme is low. In those patients who had received pre-operative iodine medication the iodine content was raised. All the patients with primary Graves's disease had received iodine, which explains the relatively high iodine level. The colloid nodules contained more iodine than the non-colloid nodules.

The tadpole metamorphosis experiments may be summarized by stating that, in primary Graves's disease, the metamorphosis was accelerated in some cases and not accelerated in others; that, weight for weight, goitrous glands were less active than normal thyreoid tissue;

that the colloid nodules were as active as the adjacent non-nodular goitrous tissue; and that the degenerate nodules were quite inactive. On the whole, these biological results show a positive correlation with the iodine findings.

Carbohydrate Metabolism.

A number of our cases in all groups showed a departure from what is regarded as a normal blood sugar curve. In the toxic group, whether primary or secondary, the blood sugar findings tended to be higher than normal, whereas hypoglycæmia occurred more often in the simple goitres. There was no constancy, however, in these findings, and though at first we were inclined to believe that the glucose tolerance afforded a useful test in the recognition of toxic goitre, subsequent experience has taught us that the test is merely suggestive and in no sense diagnostic.

In one toxic case in this series, a female patient of forty-eight years, who had been under medical treatment for diabetes for some years, and who showed a typical blood sugar picture, the diabetes disappeared completely six months after thyreoidectomy, and four years later she remained normal.

NOTES ON THE PATHOLOGICAL FEATURES OF GOITRE OBSERVED IN THIS SERIES.

(E. F. D'Ath.)

Simple Goitre.

The cases under the heading of simple goitre may be classified into two main groups: (*a*) diffuse type, (*b*) nodular type.

Diffuse Goitre.

1. *Parenchymatous Type.*—During the last four years we have had only one example of the parenchymatous type of goitre for histological examination. It occurred in a girl of twelve years of age. The gland was moderately enlarged, firm and vascular. Microscopically it showed an increased stroma of considerable vascularity and a great increase in follicles, with almost complete absence of colloid.

This type of goitre is rare in New Zealand, although apparently very common in parts of Switzerland.

2. *Colloid Type.*—The colloid type is the common type of endemic goitre in New Zealand. Only a small percentage reach such a size as to produce symptoms necessitating operation. They present the typical picture of large colloid spaces lined by flattened epithelium and filled with deeply staining colloid. In most, hyperplastic papillary projections within the acini and islands of actively hyperplastic follicles could be found scattered throughout the gland.

Simple Nodular Goitre.

The great majority of the thyreoids removed at operation showed the presence of nodules. These nodules are almost invariably multiple,

and small or of moderate size. Only occasionally have single, large, well encapsulated nodules been found.

Histologically the nodules may be classified in much the same way as simple diffuse goitre into: (*a*) parenchymatous nodules, (*b*) colloid nodules.

Parenchymatous nodules are quite common in the multiple nodular goitres of our series. In fact, in the great majority of nodular goitres one or more parenchymatous nodules can usually be found.

Most of the nodules, however, are of the colloid type, many showing small islands and spurs or hyperplasia. In the multiple nodular goitre the nodules are rarely so well encapsulated as in the single nodular type. The capsule usually contains remnants of atrophic acini embedded in fibrous tissue. Degenerative changes and cyst formation are common, especially in the moderately sized nodules.

In our series eight examples of single large nodular goitres occur. Only one of these was of the colloid type. The remaining seven were of the parenchymatous type, described sometimes as fœtal adenomata. They do not appear to differ in any way from the parenchymatous nodules of the multiple nodular goitre, except in their greater degree of encapsulation. In some of the nodules transition stages can be seen between the solid parenchymatous areas and adjacent colloid areas. It would, therefore, appear that there is no essential difference between the so-called fœtal adenomata and the colloid adenomata. They merely represent different stages in the cycle of development of the nodule.

Toxic Goitre.

The cases under the heading of toxic goitre are classified clinically as (*a*) primary Graves's disease, (*b*) secondary Graves's disease.

This classification is merely one of convenience, and is not based on any sound pathological foundation. The supposition is that primary Graves's disease appears suddenly in a patient in whom the thyreoid was previously normal, whereas in secondary Graves's disease the symptoms appear in a patient who previously has had a goitre. It is obviously impossible in many cases to determine whether the gland prior to the advent of toxic symptoms was normal, and in addition many intermediate types between the well defined examples of the above two subdivisions occur.

Primary Graves's Disease.

In the great majority of thyreoids from cases of primary Graves's disease submitted to us for histological examination, the histological picture is typical, although modified to a greater or less degree as the result of iodine therapy.

The histological features as seen in our cases do not differ from what is recorded elsewhere, and therefore they need no elaboration. Occasionally, however, we have seen thyreoids from cases presenting the typical symptoms of primary Graves's disease in which the histological picture

is that of a simple colloid goitre with or without scattered areas of hyperplasia.

Secondary Graves's Disease.

It will be obvious from the definition given above of this subdivision, and from the fact that so many of our patients with goitres of long standing develop multiple nodules, that secondary Graves's disease will very largely occur in patients with nodular goitres.

It is in this group that we have found it impossible with any degree of certainty to correlate the histological findings with the clinical picture. There are so many histological variations which occur in one and the same gland, such as hyperplasia, involution, fibrosis, degeneration and variations in colloid, storage and absorption, that it is difficult to assess their clinical significance. Just as much proliferative activity may be seen in a clinical non-toxic nodular goitre as in a toxic one.

In other words, our experience is that there are no histological or anatomical features which will serve accurately to distinguish a non-toxic nodular goitre from a toxic one.

A small percentage of our cases of secondary Graves's disease show goitres of the diffuse non-nodular type. Here again there is no reliable pathological differentiation between toxic and non-toxic cases. Some of these cases are indistinguishable from primary Graves's disease, others are indistinguishable from simple colloid goitre in its various histological manifestations.

From these observations one cannot but conclude that the histological picture merely represents innumerable variations of one and the same pathological process of hyperplasia and involution.

It will be, therefore, obvious that, however desirable the clinical classification given above may be, there is no pathological foundation for such a subdivision.

GENERAL SUMMARY.

1. A study is presented of 368 cases of thyreoid disease observed at the Dunedin Hospital over a period of six and three-quarter years.
2. Simple and toxic goitre occurred in approximately equal proportion, but many of the simple cases presented features of "border-line" toxicity.
3. The difficulties of accurate classification, particularly in the toxic classes, are discussed and arguments advanced for the abandonment of the differentiation "primary" and "secondary".
4. The family history in all classes (least marked in the primary Graves's disease group) indicates the high family incidence of goitre in this district.
5. The results of surgical treatment in toxic goitre are excellent and compare favourably with those in other important disease groups, such as biliary.
6. The operation mortality in toxic cases was 3·7%.

7. An unduly high incidence of recurrent laryngeal nerve lesion after operation is recorded.

8. Post-operative myxœdema in classical form was noted in three cases out of 319 operations in all classes.

9. Tetany occurred in three cases in the same series.

10. Our biochemistry findings indicate that the blood iodine content is higher in primary Graves's disease than in simple goitre, and that the iodine content of blood, urine, fæces and gland are all lower than normal in simple goitres.

11. Observation of our cases leads to the conclusion that the histological picture merely represents innumerable variations of one and the same pathological process of involution and hyperplasia. It is impossible accurately to correlate the pathological picture with the clinical classification.

ACKNOWLEDGEMENTS.

In conclusion, we would express our thanks to those members of the surgical staff who have operated on many of the cases reviewed in this study, for permission to utilize their records.

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CONGENITAL ATRESIA OF THE ILEUM.

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Though surgical literature is rich in reports of cases of congenital atresia of the small intestine, with records of many attempts at surgical relief, the results have been extremely disappointing, and we therefore submit this record of a recent successful case, together with some observations upon the condition and its treatment.

The occurrence is rare, though undoubtedly in some patients who die the condition is unrecognized. The relative frequency as compared with atresia of the rectum and anus is reported to be 1:4.

In 1931, when Webb and Wangensteen[1] reviewed the literature to date, some 500 cases of atresia of the small intestine had been reported, with only nine operative recoveries; and in the subsequent two years about one dozen further fatal cases have been added. Of the successful operations, six have been for duodenal atresia and three for atresia of the jejunum or ileum.

Australasian contributions to the literature consist of a number of individual case reports from both Australia and New Zealand, and in particular the successful case recorded by Sweet and Carrick Robertson[2] in 1927, and the recent paper by G. Keith Smith,[3] based on five cases occurring in Sydney, and dealing in particular with the subject of stenosis.

The case here presented differs, both in the type of the obstructive lesion and in the operative procedure adopted, from any of the previously recorded recoveries.

Case Report.

The patient was a female infant, born at full term on February 9, 1933, after a normal pregnancy and a natural delivery, in which she was attended by one of us (T.F.C.).

The mother was aged forty years, this being her second child. On the day following delivery, the nurse reported that no meconium had been passed. The anus was normal, and digital exploration demonstrated a patent though constricted rectum. A small amount of pale inspissated mucus was removed. A catheter was passed for some inches up the bowel, but an attempted irrigation was without result.

On the second day the child was restless, with frequent vomiting of a dirty greenish-brown material, and showed considerable abdominal distension. It was obvious that an intestinal obstruction was present.

Operation was undertaken by one of us (H.K.C.) on February 11, 1933, when the patient was two days old. The stomach was washed out immediately before the operation. Under light ether anæsthesia, with "Novocain" infiltration of the abdominal wall, a right paramedian incision was made with its centre opposite

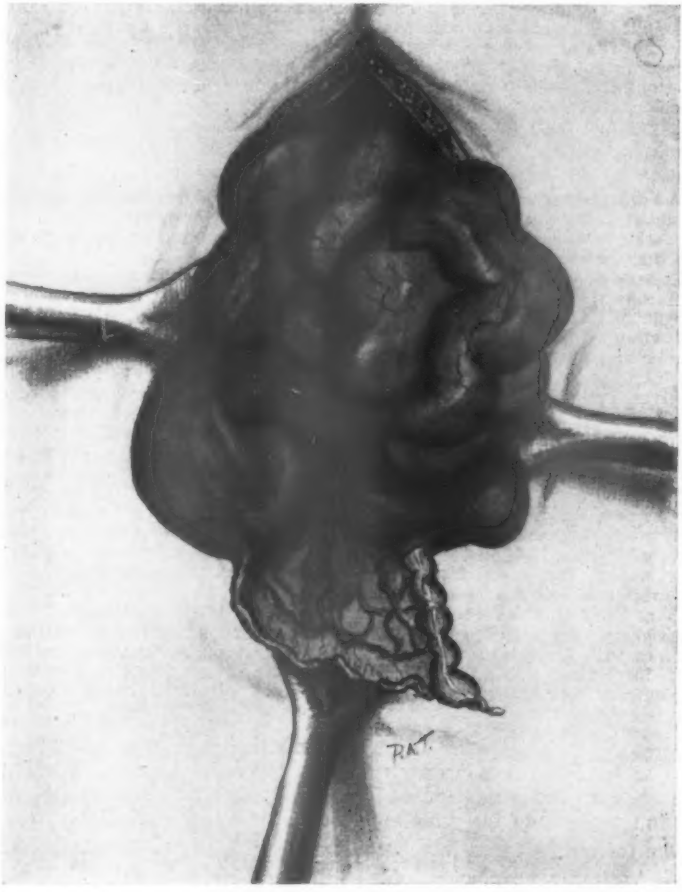

FIGURE I. Condition at operation, showing atresia of the terminal ileum with isolated segment.

the umbilicus. Some free fluid escaped, and distended small intestine presented, comparable in size with adult small bowel. This was found to end abruptly in the mid-ileum, the intestine being continued as an attenuated cord with no apparent lumen. About 7·5 centimetres (three inches) distal to the obstruction this cord came to an end, and there was a definite complete break in continuity,

followed by a separate closed loop about 2·5 centimetres (one inch) long. There was no defect in the mesentery. The terminal part of the ileum continued again as a cord to the caecum, which it entered from the right side. The ascending colon disappeared behind the mesentery of the small intestine, and no transverse colon could be identified, suggesting that a degree of malrotation was present.

It was decided to make a short circuiting anastomosis at a much lower level, and the sigmoid loop was drawn up. This was the diameter of a diary pencil, and contained some inspissated mucus. A catheter enterostomy was performed in the dilated small intestine 15 centimetres (six inches) above the obstruction, and a side to side anastomosis of the terminal dilated ileum to the pelvic colon was made, 000000 catgut being used. The abdomen was closed in layers with catgut and deep interrupted silkworm gut sutures.

Post-Operative Notes.

The enterostomy functioned well for the first four days, the average drainage being about 180 cubic centimetres (six ounces) in twenty-four hours. A first small motion was passed *per rectum* on the fourth day, and on the same day the enterostomy catheter slipped out and was not replaced.

Motions *per rectum* rapidly increased both in number and quantity with a parallel reduction in the discharge from the enterostomy. By the fourth week the fistula had closed, and the wound was soundly healed.

Feeding.—Unfortunately, no breast milk was available, either from the mother or from other sources. Feeding was briefly as follows: During the first twenty-four hours, 8·0 cubic centimetres (two drachms) of 10% glucose solution were given every hour. Thereafter, a dilute milk and whey mixture with a high percentage of sugar was introduced gradually, 15 cubic centimetres (half an ounce) every two hours on the second day, 60 cubic centimetres (two ounces) every three hours by the seventh day, and 90 cubic centimetres (three ounces) every three hours by the fourteenth day. The standardized humanized milk formula as used in New Zealand was substituted in the fourth week. Small quantities of saline solution were also given by the enterostomy tube in the first two days.

Weight.—The birth weight of the infant was 3·82 kilograms (eight pounds eight ounces). Very rapid loss naturally occurred in the early stages, and even by the fourteenth day the weight was only 2·81 kilograms (six pounds four ounces). From that time, slow but steady increase in weight has been recorded.

Progress.—From time to time the child has had short periods of abdominal discomfort with distension. Apart from this, the progress has been satisfactory, and in July, 1933, five and a half months after the operation, her weight is 4·95 kilograms (eleven pounds) and her general condition is good.

TYPES OF OBSTRUCTION IN ATRESIA.

Considerable variation occurs in the type of obstructive lesion, and the three-group classification of Forssner (quoted by Morley[4]) requires extension to include the wide range of anatomical variations presented.

The following types have been noted:

1. A simple narrowing of the lumen of the bowel, without other marked abnormality.

2. A diaphragm of mucous membrane across the lumen of the bowel, causing either stenosis or complete occlusion.

3. A breach of continuity of the bowel, with the blind ends united by a cord.

4. A complete breach of continuity with the blind ends unconnected. This type may, or may not, possess a defect in the mesentery.

5. Multiple interruption of continuity with isolation of one or more small segments, the ends of which are closed.

It has also been noted by some observers that other anomalies of intestinal development may be associated, and the operation findings in our case lead us to believe that reversed rotation (Dott[5]) is present in addition to the atresia of type 5.

DISTRIBUTION.

Davis and Poynter[6] found the frequency of occurrence in different parts of the small intestine to be as follows:

Duodenum—	
(*a*) Above papilla	59 cases
(*b*) Below papilla	75 cases
Jejunum	60 cases
Ileum	101 cases
Multiple	67 cases

ÆTIOLOGY.

Numerous theories have been advanced to explain the development of atresia. It would seem that there is no single explanation to account for the widely different forms which are exhibited. Among those theories which have received most support are:

1. Overgrowth of epithelium. According to Tandler (Morley[4]), overgrowth of epithelium occurs normally in the duodenum between the fourth and tenth weeks of embryonic life, causing a temporary occlusion which may persist. Histological evidence from one of his own cases led Morley to believe that occasionally a similar state of occlusion occurred in the ileo-caecal valve.

2. The site of an "embryological event". This theory, advanced by Bland-Sutton, explains the occurrence of atresia at certain definite situations, such as the duodenal papilla, Meckel's point, and the ileo-caecal junction, but does not account for the large number of cases which occur at other than these sites, or the cases of multiple atresia. At the sites mentioned, important embryological developments normally occur, as for example the obliteration of the vitello-intestinal duct at Meckel's point, and the development of the pancreas at the duodenal papilla; and it is suggested that an exaggeration of these normal processes may cause obstruction.

3. Developmental accidents. (*a*) Intussusception in fœtal life. (*b*) Volvulus of a small loop leading to isolation and atrophy (Morley). (*c*) Strangulation of a loop in the umbilical ring during the process of return of the midgut loop to the abdomen in the tenth and eleventh weeks of embryonic life (Clogg[7]).

4. Fœtal peritonitis. This explanation has been seized upon by many writers, but the evidence in support of it is unconvincing.

5. Primary sclerosis of arteries of the mesentery, with secondary degeneration of the mucosa (Davis and Poynter[6]). This theory is

advanced in explanation of those cases in which a gap in the mesentery is apparent, but such a defect might also be accounted for by the volvulus or strangulation theories.

6. A functional error depending upon irregularity in the distribution of the nerve supply (Fraser[8]). Smith[3] adopts this neuro-muscular explanation for cases of stenosis without any other obvious mechanical impediment.

It will be seen that while each of the above theories affords a reasonable explanation for a limited group of obstructive processes, no single theory accounts for the complete range of types which may occur.

SYMPTOMS AND DIAGNOSIS.

With the sole exception of some cases of simple stenosis, atresia results in total obstruction, and attention should therefore be directed to the condition very soon after birth. The average age before recognition in published cases is, however, five days.

Absence of meconium, vomiting and abdominal distension are the three principal signs, each depending upon the level of the obstruction. With obstruction high in the duodenum, the vomiting is the most prominent symptom. It is very early in onset, and is free from bile, while meconium may be present in small amount. Obstruction below the duodenal papilla will lead to a vomit containing bile and an absence of meconium.

Abdominal distension is most marked in atresia of the jejunum or ileum. It may even be present at birth.

DIFFERENTIAL DIAGNOSIS.

Only those conditions producing obstruction in the first few days of life need be considered in the differential diagnosis.

Atresia of the rectum or anus should present no difficulty in differential diagnosis, but must first be excluded as being probably the commonest cause of congenital obstruction.

Congenital œsophageal stricture is characterized by dyspnœa, cyanosis, profuse salivation and the immediate regurgitation of swallowed fluid.

Errors of intestinal rotation producing obstruction. It may be impossible to exclude this diagnosis, but as early surgical intervention is indicated for this condition as for atresia, the exact distinction is unimportant.

Congenital hypertrophic pyloric stenosis seldom gives rise to symptoms before the second or third week, but one of us (T.F.C.) has diagnosed the condition in two cases during the first week, with confirmation at operation on the eighth day.

The type and periodicity of the vomiting, and in particular the demonstration of the pyloric tumour, are features of distinction.

TREATMENT.

It is obvious that in all but the minor degrees of simple stenosis the condition is incompatible with prolonged life, and that the only possible treatment is surgical.

So hopeless has the problem of treatment appeared to some writers that it has been stated that the disproportion between the diameters of the gut above and below the obstruction presents an insuperable barrier to anastomosis, and that any attempted restoration of continuity is futile, but it will be seen from the review of reported recoveries (Table I) that, on the contrary, such a procedure affords the only hope of success.

TABLE I.

Successful Operations for Atresia of Small Intestine.[1]

Date.	Author.	Country.	Site.	Type.	Operation.	Age of Patient.
1911	Fockens.	Holland.	Atresia of mid-ileum.	4	Side to side ileo-ileostomy.	8 days.
1916	Ernst.	Denmark.	Duodenal atresia below papilla.	3	Antecolic duodeno-jejunostomy.	11 days.
1916	Weeks & Delprat.	United States of America.	Third part duodenum.	—	Gastro-enterostomy.	6 days.
—	Richter.	United States of America.	Duodeno-jejunal junction.	—	Posterior gastro-enterostomy.	4 days.
1924	Cutler.	United States of America.	Duodenal obstruction.	—	Posterior gastro-enterostomy.	4 days.
—	Porter & Carter.	United States of America.	Duodenal atresia.	—	?	—
—	Steward.	England.	Duodenal atresia.	—	?	—
1926	Sweet & Carrick Robertson.	New Zealand.	High jejunum.	4	Antero gastro-jejunostomy.	9 days.
1927	Demmer.	Austria.	Ileo-caecal.	2	Ileo-caecostomy and resection of vestige of caecum.	—
1933	Corkill.	New Zealand.	Mid-ileum with segmentation.	5	Ileo-sigmoidostomy and ileostomy.	2 days.

[1] For those cases not specifically included in our table of reference, see the papers of Loitman[12] and Webb and Wangensteen[1].

Two courses are open to the surgeon: (i) Relief of the obstruction by an enterostomy, to be followed by an anastomosis at a later date. (ii) Immediate restoration of continuity by a primary anastomosis.

At first sight the former appears to be the operation of less risk, and to be in accordance with accepted surgical principles, but though the majority of recorded cases have been treated in this way, there is no report of this procedure having other than a fatal issue. The longest survival is reported by Smith[3] in a case of partial stenosis in which the child lived for forty-one days after low ileostomy.

It would appear that the new-born child does not readily tolerate the dehydration of an enterostomy, and that, on the other hand, anastomosis in neo-natal life even in the presence of obstruction, does not carry the same risks as in adults, probably on account of the less toxic condition of the intestinal content.

Young infants appear to stand major surgical procedures relatively well. In 1910, Waugh[9] performed resection and side to side anastomosis for an obstructed hernia in an infant of twenty-four hours, with survival for four weeks, and since then there have been numerous reports of successful major intestinal operations in new-born children.

An anastomosis between loops of such disproportion, as occurs in congenital atresia, presents considerable technical difficulty. Clogg[7] suggested that this might be overcome by filling the collapsed loop with water through a hollow needle, and Webb and Wangensteen[1] more recently advise ballooning it with air in the same way.

Smith,[3] discussing simple partial stenosis, which he attributes to a neuro-muscular defect, infers that the narrowing of the bowel below is a physiological contraction on emptiness which may be overcome by artificial dilatation. He therefore suggests for such cases systematic dilatation by air or water through a rectal catheter after diagnosis at laparotomy.

It appears to us, however, that, accepting Smith's explanation, anastomosis across the immediate defect is indicated in such cases, allowing the natural passage of intestinal contents to effect the stimulus required for dilatation of the distal collapsed segments. Moreover, it may be impossible to differentiate at operation between simple stenosis (type 1) and a partial diaphragm (type 2).

It will be seen from the table of successful operations that no single standard anastomosis can be laid down, the appropriate procedure being dependent on the type and level of the block.

For duodenal and high jejunal atresia, some form of gastro-jejunostomy or duodeno-jejunostomy is required, but for obstruction lower down in the small intestine several different operations are possible.

In Focken's original case a close short circuiting anastomosis was possible, and Demmer was able to resect the maldeveloped ileo-caecal junction and perform ileo-caecostomy.

The details of the findings and operations in the successful cases as published are given in Table I.

In our case a wide short circuit was considered necessary, and ileo-sigmoidostomy appeared to offer the best chances of success, especially in view of the unknown condition of the transverse colon and the proved patency of the distal colon.

We are aware of the disadvantages which follow such an anastomosis in the adult, but we think it reasonable to believe that in the developing child the small remnant of colon will take on sufficient absorptive function to prevent a permanent looseness of the bowels. The subsequent progress of the case has tended to justify this assumption.

Whether the addition of a temporary enterostomy was necessary is perhaps open to doubt in view of the experience of others.

At the time of operation we felt it to be imperative to relieve the distension above the block and to avoid strain upon the suture line. Both these results were achieved, and no trouble was experienced in obtaining a natural closure of the fistula.

At that time, however, we were not acquainted with the knowledge that such a procedure, whether alone or in combination with anastomosis, had hitherto been uniformly fatal.

SUMMARY.

1. A case of congenital atresia of the ileum with recovery after ileo-sigmoidostomy and enterostomy at the age of two days is reported.
2. Various theories of ætiology are noted.
3. Surgical treatment is discussed, and a table of published successful cases is presented.

ACKNOWLEDGEMENTS.

We wish to express our thanks to Dr. Eardley L. Button for assistance at the operation, to Dr. P. A. Treahy for the illustration, and to Dr. J. V. Cable, of the Otago University Medical School, for help with the references.

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Surgical Technique.

NOTES ON THE TREATMENT OF SIMPLE FRACTURES: A CONFESSION OF PERSONAL PRACTICE.

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> What cases are to be reduced or attempted, and when and which and when not; the hopes and dangers in these cases; and why part becomes maimed and how and how not: and why a certain part is atrophied and where and how, and in what cases to a less extent. And why fractured parts unite sooner or slower: how distortions form and the remedy for them. In what cases there are external wounds either at first or afterward: and what not . . . . That physicians are deceived and by what means in what they see and what they devise. Established rules with regard to bandaging, preparation, presentation of a part, extension, adjustment, friction, suspension and placing of a limb, attitude, seasons, diet.—Hippocrates.

Thus did the Father of Medicine and Surgery summarize in advance the contents of his great treatise on fractures, warning his readers what they might expect in the statement of his personal convictions, and in the description of his methods of treatment. So, too, but with mind, it is to be hoped, tuned to a state of all due humility by that sentence in the first paragraph of Hippocrates's treatise that "physicians who fancy themselves learned in these matters are they who commit blunders", would the present writer attempt in this short paper to put on record his personal beliefs and convictions regarding fractures and their treatment, with some general account of his present practice, both the result of an experience extending through the war and post-war periods. He, too, would warn his possible readers in advance that his article is concerned far more with the general principles of treatment and with the indications for treatment of the various types of fractures of the limbs, rather than with the details of methods of treatment. It surely is with the former—the principles of treatment and the indications for treatment—rather than with the latter—the details of particular methods—that the medical student and young practitioner should be chiefly concerned. It is surely a knowledge of the disabilities that are likely to follow such injuries, and how these disabilities arise and come about, and the need for their prevention, that should form the chief platform of surgical education in regard to injuries and their treatment, rather than a heterogeneous collection of facts and a more or less confused jumble of ideas about various splints and more or less complicated forms and types of apparatus. So furnished, the young practitioner will be able to educate himself, to marshal his experience into a useful body of knowledge to serve as a basis for judgement. So will he not be liable to be swayed hither and thither by each new method or piece of apparatus vaunted by its inventor, not to fall into the error as common today as it evidently was in old Greek times.

I am under the necessity of giving the longer directions on this subject, because I know physicians who have the reputation of being skilled in giving the proper positions to the arm in binding it up, while in reality they are only showing their own ignorance. But many things in our art are judged of in this manner, for people rather admire what is new, although they do not know whether it be proper or not, than what they are accustomed to, and know already to be proper: and what is strange, they prefer to what is obvious.—Hippocrates.

General Principles and Beliefs.

Before proceeding to discuss each of the common type of limb fractures in turn, the writer will state the general principles and beliefs he has arrived at, from which are drawn the deductions for "treatment of the individual cases". Those of his possible readers who reject any or all of these principles will, of course, find themselves, too, at variance with him in his therapeutic inferences and his choice of method in individual types and cases.

1. That the object to be kept in view right through the treatment and period of supervision of a fracture case, is the prevention of permanent disability, whether this be the immediate and direct or the late and indirect result of the injury.

2. That where such disability can be prevented by two or more possible methods, the simpler should be chosen in preference to the complicated: and non-operative in preference to operative: and this latter preference is all the more to be enforced where the operative experience of the surgeon in this class of case is limited.

3. That in certain fractures, operative methods alone are to be relied upon to prevent disability; and that in such cases the operation should be performed only by a surgeon experienced in such work; but that it behoves all who treat fractures to realize what cases and what circumstances demand early operative intervention.

4. That in each type of injury and fracture certain characteristic disabilities are liable to occur; that it is of the first importance to know these in advance and to know what factor or factors in the situation are responsible for the production of these particular disabilities.

5. Such disabilities arise in a variety of ways and from the following elements in the fracture situation:

(*a*) From delay or defect in the process of union. Union completely fails in the production of a more or less firm, a more or less flail type of pseudarthrosis. The final stage of firm consolidation is delayed so long that the process of mobilization of joints is greatly delayed. Or the union seems firm, but is not firm enough and the bone yields at a later stage under the body weight. Or, on the other hand, the amount of new bone formation is excessive in amount and unfortunate in its situation, blocking the movement of joints and interfering with the smooth working of muscles and tendons, pressing on and interfering with the function of nerve trunks.

(*b*) From the persistence of certain displacements of the bone fragments. In the case of the shafts of the long bones, persistence of displacements leads to permanent deformation with alteration in the line of weight transmission through them and through the portion of the limb distal to the fracture level; in the case of fractures involving joint surfaces it leads to irregularities in the fit of the bone ends forming the joint. In both cases to the immediate disability must be added the likelihood of progressive development of osteoarthritic changes in the joints so condemned to misuse in the future.

(*c*) From the adhesions forming between the soft parts injured and the underlying bone, between the soft parts themselves, and within joint cavities.

(*d*) From the disuse of the part over a long period of time, resulting in wasting of muscles, circulatory stagnation, loss of motor memory for the actions of the limb which take place in life automatically and more or less unconsciously.

(*e*) From the shock and injury to the patient's instinctive and emotional nature, resulting in all manner of functional disabilities.

(*f*) From the involvement of the injured parts in an infective process.

6. The severity of these various disabilities will depend on an interaction of two or more of the following factors in the situation:

(*a*) The actual degree of violence of the accident, with the amount of material damage and displacements inflicted on the part.

(*b*) The presence or absence and severity of the infection.

(*c*) The intensity and duration of the inflammatory reaction following even a purely aseptic injury.

(*d*) The efficiency of the treatment or otherwise.

(*e*) The age, weight and physical build and general state of health of the patient.

(*f*) The "nervous" or "psychologic" type of the patient.

(*g*) Factors in the patient's social and economic status and environment.

7. Thus the factors responsible for the final disability may be: (i) present in the circumstances of the accident; (ii) added by the treatment or lack of treatment; (iii) present in the patient's bodily and mental constitution before the accident; (iv) present in the patient's social and economic position before and after the accident; (v) become added in the future by the osteoarthritic reaction of the tissues of the joints of the limb, consequent upon inevitable stress and strain on them through altered mechanical conditions induced directly by the accident.

8. That a full consideration of all these factors in the situation is essential if disability is to be prevented or reduced to a minimum; that the anticipation of disability is necessary for its prevention; that such an analysis of all the factors in the situation is an essential condition of such anticipation and prevention; that all the information obtained by an historical reconstruction of the accident, by the clinical examination of the limb and course of the case, by the examination of X ray plates, by operative findings, should all be assessed and regarded in the mind from this one point of view—how they are likely to disturb future function, to form the basis of future disability.

9. That the tradition and atmosphere toward fracture cases within which a medical student should grow up, should be just such a one of viewing and assessing all things in terms of future function, not an atmosphere of splints and appliances, and weights and pulleys, and such like. No doubt, in the absence of such a pedagogic atmosphere and tradition, experience will teach the intelligent and the conscientious, but at what a cost to their future patients. Moreover, the disabilities resulting from fracture injuries are so simple in their production and in their nature, are so capable of explanation and understanding in the simplest terms of elementary mechanics, of the anatomy and physiology of locomotion, that there is no need for the student to await the teaching of experience. Here, if anywhere, he can learn in an a priori method without any danger of colliding seriously with the educational ideal of "learning by doing".

10. In such an evaluation of factors, the analysis and assessment from the point of view of future function, of the displacement of the bone ends or fragments should take pride of place. The student should learn what elements in the displacement in what cases are important, what, in what cases, unimportant in this all-important matter of future function. This leads to the dogmatic statement:

11. Some displacements matter; their correction is essential at almost all costs. Other displacements do not matter; too great a price should not be paid by surgeon or patient in attempts at their correction. Further, in a particular fracture with displacement, it is likely that some elements in this displacement matter and others do not. Every student and doctor should know these elements of displacement, be able to recognize their presence or absence, and know why they are important or otherwise.

12. As regards the power of repair, by far the most important agent in the rapid consolidation of fractures of the shafts of long bones is the subperiosteal

deposit of new bone around the fracture. Hence subperiosteal fractures and fractures without displacement of the bone ends through the periosteal sheath unite quickly. Hence fractures in children unite more quickly than corresponding fractures in adults. Hence fractures with complete laceration or rupture across the whole circumference of the periosteal sheath, and with complete disengagement of the bone ends, especially as regards complete firmness of the new bone sufficient to bear weight, unite slowly and take a long time to reach maturity of union, and that, even after operative reduction with careful and accurate replacement of the bone ends. This is because they have to rely for union on new bone formation from the bone shaft itself, a subperiosteal bridge of new bone across the fracture gap being largely lacking. This is the type of fracture, too, which is liable to yield late and insidiously under the burden of weight bearing.

13. On the other hand, fractures which open up and involve cancellous tissue, unite even in malposition with the greatest certainty and rapidity; embarrassingly so, indeed, if attempts to correct displacement are left for two or three weeks. Hence the rapid union in impacted fractures, in fractures involving the bone ends, in articular fractures, in fractures of the *os calcis*, and in comminuted fractures generally.

14. As regards the union of fractures of the shafts of the long bones, absolute fixation such as is aimed at in the use of metal plates and screws, discourages the union of the compact bone ends by the excessive rigidity and immobility they induce. Too sound a mechanical job means only too often a poor biological job. Where the continuity of the periosteal sheath is intact they are not needed; where the periosteal sheath has been completely disrupted, they prevent that stimulation through slight movement of the compact bone ends on each other, which is so needed in just this type of slowly uniting bone (see section 12).

15. It follows that the use of metal plates and screws in fractures of the shafts of the long bones should be interdicted. In fractures with integrity more or less complete of the periosteal sheath, they are unnecessary. In fractures with overlapping and disruption of the sheath, they endanger instead of promote union.

16. In any case, the use of any form of internal fixation of the bone fragments is quite unnecessary in transverse fractures with overlapping. All the open operation should effect is the reduction of the displacement. Once the displacement is reduced, the naturally occurring serrations interlock and are quite sufficient guarantee against redisplacement, provided the fracture is from the moment of their engagement handled and treated as a closed fracture without displacement.

17. Internal fixation to prevent recurrence of the displacement is necessary in those spiral and oblique fractures of the shafts in which operation has been found necessary for reduction. This fixation should be effected by absorbable materials such as kangaroo tendon or autogenous bone pegs hammered in through drill holes. Intramedullary pegs but serve to destroy good bone-forming endosteum. Not only are these absorbable, but they do not confer complete fixation, and hence do not check the often scanty and tardy formation of new bone from the dense bone ends. Once fixed in this way, such fractures too should be handled and treated as closed fractures without displacement.

18. In fractures of the bone ends involving and disturbing the smooth articular surfaces and the articular fit, absolute reduction and absolute fixation are required. The persistence of very slight degrees of displacement here, sooner or later, spells osteoarthritic degeneration of the joint. Open operation with absolute reduction is therefore indicated. Absolute fixation by means of bone pegs carries here with it no danger of non-union, as the masses of cancellous tissue naturally unite quickly and surely. Metal pegs and screws are contra-indicated, as they destroy the soft cancellous bone and often fail to hold the fragments in position. There is not the same objection, however, to the use of a metal wire used circumferentially to bind the two fragments of a broken patella or to bind the olecranon back on to the ulnar shaft.

19. Compact bone as met with in fractures of the shafts of the long bones can usually, if brought into reasonably good position and held there neither too loosely nor too rigidly, be relied upon to make a successful attempt at union. If for any reason, however, this their first attempt at union is frustrated, they pass on through the natural phases of the repair process to a high degree of sclerosis, which in itself offers a great resistance to further attempts to stimulate the bone to make a second effort at repair. This is an argument for early reduction and reasonable immobilization: for open operation in all cases in which at the end of three or four weeks union does not seem, despite fair position, to be progressing satisfactorily. Further delay makes more and more difficult and uncertain the spontaneous union of the bone ends. Where at such a delayed operation the bone ends are found already sclerotic, the insertion of an inlay bone graft across the fracture is indicated, but this should be done with as little disturbance of the external vascular connexions of the bone ends as possible.

20. In all cases reduction of the elements in the displacement that make for disability and the securing of sound union are the first desiderata. Mobilization of muscles and joints should be commenced just as soon as it is certain that these two conditions are being successfully fulfilled, but not before.

21. Fractures of the shaft of the long bones of the lower limbs in which complete periosteal rupture has taken place, should be protected from weight bearing for a long time. The effects of weight bearing should be watched most carefully and at frequent intervals to detect the first signs of yielding of the seat of fracture under the body weight. This is liable to take place quite long after union seems quite firm by all other tests. In most such cases it will be wise to insure against such a yielding by requiring the patient to use a walking calliper or other form of partial weight transmitting appliance until such time as it seems certain the period of danger is past.

Notes on the Treatment of Individual Fractures.

The Clavicle.

The objects of treatment of fracture of the clavicle are threefold: (i) to reduce the displacement as far as possible or as is thought advisable, (ii) to maintain the degree of correction obtained where this is possible and advisable, (iii) to maintain and restore the functions of the upper limb and particularly of the shoulder joint.

For the fulfilment of the first two aims in fractured clavicles, over two hundred methods and devices have been recommended—a tribute to the difficulty and in many cases the impossibility of maintaining the fracture reduced against the displacing weight of the upper limb. Fortunately, fractures of the clavicle belong to that class of fractures in which persistent displacement does not necessarily spell disability. Many surgeons in the past, both honest and celebrated, have confessed how difficult and often impossible it is, even with the most ingenious and complicated appliances, to restore the alignment of this fractured bone. To take the testimony of two of the greatest, hear first the voice of Hippocrates speaking out of the mists of antiquity and speaking with frankness and with humour:

> For the most part, then, it should be known, no harm results to the shoulder or to the rest of the body from fractures of the clavicle. A deformity, however, may arise from fracture of the clavicle, and in these cases it is very great at first, but by and by it becomes less. . . . When, then, a fracture has recently taken place, the patients attach much importance to it, as supposing the mischief greater than it really is, and the physicians bestow great pains in order that it may be properly bandaged; but in a little time, the patients having no pain, nor finding any impediment to their walking or eating, become negligent; and the physicians, finding they cannot make the parts look well, take themselves off, and are not sorry at the negligence of the patients, and in the meantime the callus is quickly formed.

Over two thousand years later, the great Billroth:

> In adults, I never succeeded in adjusting and preserving the fragments in perfect position if the displacement were of any great extent. I never saw any loss of function in the affected extremity, even when the fracture united with a considerable amount of displacement. When opportunity occurred of seeing these cases some years after the injury, I was often astonished to see how far the projecting ends of the fragments had become absorbed and the thick mass of callus levelled down. Numerous preparations in our museum show how greatly these deformities improve with the lapse of time.

Lester reports 420 consecutive cases in many of which no attempt at reducing the fracture or holding it reduced was made, other than by supporting the weight of the arm by means of a sling and binder, yet "from the point of view of function and comfort the results were nearly 100% perfect", whilst the average period of treatment in complete fractures was only twenty-five days, and in incomplete, twenty-one days.

All this is not to be interpreted as an excuse for slackness or negligence; the displacement should be corrected and the reduction maintained as far as is reasonably and comfortably possible. But to put the patient to great discomfort, to immobilize the upper limb and run the risk of inflicting irreparable stiffness on the joints of the elderly, all in an attempt, from the outset vain, of holding corrected a displacement which in itself spells no disability, is a form of treatment surely to be frankly discouraged by all honest teachers.

For the most part, the cases fall into the following classes:

(*a*) Greenstick and subperiosteal fractures without displacement. In these, force back the angulation, if any, with the thumbs, and support the weight of the upper limb with a simple weight-supporting sling.

(*b*) Fractures with complete periosteal laceration and overlapping. The best result, compatible with the patient's comfort, should be obtained by means of any form of retentive apparatus that attempts to hold the shoulder back and to support the weight of the limb, and that does not at the same time immobilize the shoulder joint. Such methods as strapping the shoulder and arm to the side with adhesive strapping should be given up. The writer uses the three-handkerchief method, not looking for perfect reduction by any means, but being content with as good a correction as can be obtained by a daily inspection and readjustment of the bandages within the limits of toleration of the patient.

(*c*) When it is of importance that there should be no deformity, complete recumbency in bed is indicated.

(*d*) Open operation is very occasionally needed in cases in which a sharp spicule of bone threatens to perforate the skin, and when deformity, already present and fixed by callus formation, is specially required to be corrected. Open operation should consist here of a mere reduction and engagement of the bone ends, the condition then being treated as a recent subperiosteal fracture without displacement. Internal fixation is unnecessary unless the fracture is very oblique and unstable, when the fragments may be drilled and lashed together with kangaroo tendon.

The Scapula.

Fractures of the body of the scapula require merely that the limb should be supported and scapular movements inhibited for two to three weeks. This does not mean that the shoulder joint need be fully and completely immobilized throughout more than half of this period, if so long.

Fractures of the neck and of the glenoid surface of the scapula with much displacement require open reduction and internal fixation, preferably with wire. It is all important to restore the integrity and smoothness of the articular surface, especially in a labouring man; otherwise osteoarthritis will develop. After operation, mobilization of the joint with reeducation of deltoid function should commence very early.

The Upper End of the Humerus.

(*a*) Impacted fractures and subperiosteal fractures of the upper end of the humerus unite with great rapidity. Deformity in these does not matter; they should be left impacted. Mobilization of the shoulder, with retention of deltoid memory and action, should be commenced early. Put a pad in the axilla; sling the arm from the wrist, leaving elbow free to hang; bandage arm lightly to the trunk.

(*b*) Fractures with complete periosteal rupture and lateral displacement, but without overlapping, should be treated by extension or immobilization in a plaster in an abducted position, a good traction along the abducted limb being maintained during the application of the plaster, which should enclose the chest and sit over both shoulders and extend down the arm as far as the wrist.

(*c*) Fractures with complete periosteal rupture and overlapping are best treated by open operation. Expose the bone ends; abduct and externally rotate and pull upon the lower fragment, and it will rapidly engage and lock with the small upper fragment and remain securely locked so long as the limb is held abducted and externally rotated, in which position immobilize in plaster as in (*b*).

The Shaft of the Humerus.

The indications for treatment of fractures of the shaft of the humerus are the typical indications for the shafts of the long bones:

(*a*) In subperiosteal fractures in which angulation and rotation displacements are alone liable to occur, immobilize the fragments by two to three coaptation splints, sling the limb from the wrist only, leaving the weight of the upper limb free to distract the bone ends, and lightly bind the splinted arm to the trunk.

(*b*) In transverse fractures with lateral displacement but no overlapping, and in spiral and oblique fractures, use continuous extension in a Thomas splint.

(*c*) In transverse fractures with overlapping, use open operation with reduction and engagement of bone ends, but no internal fixation. Apply coaptation splints and treat the fracture as if it were a subperiosteal fracture without displacement, but it will take longer to become solid than a true subperiosteal fracture.

The Lower End of the Humerus.

(*a*) In fractures without displacement, immobilize the fragments in flexion and commence active, not passive, movements in ten days' time. Watch carefully for signs of *myositis ossificans*.

(*b*) With full displacement of the lower fragments backwards, reduce by hyperextending the lower small displaced fragment on the upper fragment, and then, whilst maintaining constant traction along the length of the forearm, slowly and steadily flex the elbow, pressing the lower fragment forwards and downwards with the fingers of one hand. It is important to make sure that the bone is not being set with a lateral tilt inwards or outwards so as to produce an ultimate *cubitus varus* or *valgus*. Fix in an easy position of flexion. Movement of the elbow should be active, and commence in about ten days; it does not do to be in any hurry to get full extension. This may take weeks, even months, but if reduction has been perfect, and immobilization not too prolonged, it will eventually come.

(*c*) These fractures in children unite very quickly. A different class of case is that in which reduction has been very imperfectly carried out, and the fragments are already fixed in callus. Then open operation from behind is necessary with removal of all the callus and leverage of the fragment into position. In such cases the fragments may show a tendency to return to their former position; internal fixation by bone pegs or lashing with kangaroo tendon is then necessary.

Fractures of the Olecranon.

(*a*) When a fracture of the olecranon is subperiosteal with little or no displacement, immobilize the elbow at a right angle.

(*b*) When much of a gap is present, open operation is indicated. The best method of fixation is by wire. The lower fragment is transfixed transversely from within outwards through a drill hole, but the wire should gain its hold and grip on the small olecranon fragment by transfixing not the bone but the triceps tendon just at its insertion. In this way a sort of circumferential wiring is effected. Mobilization can commence almost at once.

Fractures of the Radial Head.

Fractures of the radial head fall into two classes: (*a*) those without displacement, (*b*) those in which a considerable portion of the head is displaced so as to block radio-ulnar movement. In such cases deformity of the head of the bone is to be expected, and this will lead inevitably, even in young people, to the osteoarthritic degeneration. Since complete removal of the head gives such excellent functional results, it is surely reasonable to perform this operation at once, and not wait until the superior radio-ulnar joint is blocked by an overgrown head, or become the seat of osteoarthritis. Even when the fragment, completely detached, can be fastened back in position apparently quite satisfactorily, the writer is of opinion that it is much better to resect the head, leaving only so much of the neck as will remain engaged within the circle of the orbicular ligament.

The Shafts of the Radius and Ulna.

(*a*) Subperiosteal, greenstick fractures and fractures of the shafts of the radius and ulna without complete laceration of the periosteal sheath require merely straightening, followed by immobilization between coaptation splints or anterior and posterior moulded plaster slabs. The writer is of opinion that the best position for fractures of the forearm is that of full supination. Early union is to be expected in these cases, and early mobilization to regain pronation should be carried out. It always seems to be easier to regain full range of pronation when the limb has been immobilized in supination than to regain full range of supination when the arm has been fixed in semipronation.

(*b*) Fractures of the radius alone with complete rupture of the periosteal sheath and marked lateral displacement and overlapping should be subjected to open operation, the bone ends levered into position, locked there, and the case treated as in (*a*). If the fracture be oblique or spiral, drill holes and lash the ends together with gut.

(*c*) Fractures of ulna shaft alone, even if markedly displaced, will not require open operation, as the radius is the moving and important bone in radio-ulnar movement, and delayed union or even non-union of the shaft of the ulna alone is not of itself a very serious disability. At the worst, non-union of the ulna reacts well to the implantation of a bone graft. Bone grafting the radius for non-union is a much more difficult and less certain affair.

(*d*) Complete fracture of both bones, with complete periosteal sheath rupture and marked lateral displacement, require open operation with reduction. When the fractures are transverse, no internal fixation will be required. When they are oblique or spiral, drill holes and lash the bone ends together with catgut or kangaroo tendon. Intramedullary pegs should not be used; plates should not be used. Immobilize the fragments after operation as usual, remembering that because of the complete periosteal disruption, union may well be slow and secondary late bending liable to occur.

Colles's Fracture.

Type (1). Simple impacted Colles's fracture occurs with little deformity in elderly people. Immobilize the arm lightly on a Carr splint and commence at once daily massage and active movements.

Type (2) is an impacted or unimpacted fracture with typical backward angulation and bodily displacement backward and outward. Under general anæsthesia, forcibly angulate the small lower fragment backwards almost to a right angle on the upper, and at the same time draw it forcibly downwards in this

excessively angulated position. The bone ends thus being engaged, undo the angulation, at the same time correcting the outward displacement. This manœuvre requires a firm grip directly on the small lower fragment, which should be grasped with both hands between thumbs at the back of the fingers (in front): the firm fixation of the upper fragment should be effected by an assistant.

A Colles fracture fully reduced becomes at once very stable, and indeed the stability of the correction may be taken as a measure of its completeness. There is no tendency to recurrence of any of the elements of the displacement, except perhaps of posterior angulation, and this can easily be controlled during the application of the two plaster slab splints, a portion extending from the knuckles to the olecranon and an anterior from the palm of the hand up round the bend of the elbow to the lower part of the upper arm. These are applied in full supination. It always seems to the writer easier to regain pronation in a Colles fracture treated in supination than supination in one fixed in pronation. Massage and guarded active movements should be started.

Type (3) is that in which attempts at reduction have been unsuccessful; two to three weeks have elapsed and the fragments are already fixed in malposition by callus. Here open reduction is indicated. The fragments are dug out of the callus, every vestige of which should be removed; a lever is placed in between the fractured surfaces and the lower fragment is levered forcibly into position. Frequently, to keep it there, it is necessary to force the wrist into full palmar flexion. Needless to say, it should be kept in this position for no longer than is absolutely necessary—a week at most—for the prevention of recurrence of the displacement.

Fractures of the Neck of the Femur.

(*a*) In children and young adults, the separated epiphysis or partial fracture of the neck of the femur requires forcible abduction and internal rotation of the limb, with immobilization in this position in a plaster spica extending from the ribs to the toes, this to be maintained for two to three months. Walking during the first six months to be with the aid of a weight-transmitting calliper.

(*b*) Juxta-trochanteric fractures, often with comminution of the trochanteric region and impaction, in all except the very aged and decrepit require similar treatment to (*a*). The writer usually manipulates and fixes these fractures in old people under spinal analgesia. Immobilization for two to three months is required. Before weight bearing is permitted, the occurrence of sound bone union should be verified by X rays.

(*c*) Subcapital fractures in healthy middle-aged adults are usually given open operative treatment. This has two great advantages. In the first place the surgeon can make quite sure of absolute reduction and close apposition of the fractured surfaces, and learns by inspection of the fracture exactly what position of the limb allows of this forced accurate apposition. Secondly, the introduction of a bone peg assures bony union. Here, above all places in the body, the writer considers the use of metal pegs anathema. They destroy cancellous bone where this is most badly needed; they do nothing to encourage union; they introduce no osteogenic element.

The two big bugbears after fracture of the neck of the femur are: (i) the occurrence of non-union, (ii) the development of osteoarthritis in the joint. In elderly patients the latter cannot always be avoided; indeed in a surprising proportion of the cases of fractured *cervix femoris* in elderly patients varying degrees of osteoarthritis exist prior to the accident; in many cases this constitutes an important factor predisposing to the occurrence of the fracture.

Fractures of the Shaft of the Femur.

(*a*) Subperiosteal fractures of the shaft of the femur, or fractures with more or less intact periosteal sheath and no displacement beyond angulation and rotation, require no more than continuous extension in a simple Thomas splint, or even fixation in a plaster of Paris spica. Angulation can be corrected even late or when the bone ends are already encased in callus, by a combination of

longitudinal traction and lateral pressure on the convexity of the deformity by pads and bandage straps. The persistence of some degree of rotation deformity matters very little in fractures of the shaft of the femur; the presence of the ball and socket joint above still allows normal action and direction of the knee joint. Whether the limb be rotated in or out at the seat of fracture, a contrary movement or position at the hip joint automatically corrects this and allows walking with the foot pointing forward.

(*b*) Oblique and spiral fractures with marked lateral displacement, but not with complete overlapping, require the extensive traction that can be applied only by direct skeletal traction. The writer uses Pearson's ice tong callipers and finds them immensely satisfactory. He has to confess to a prejudice dating from war days against transfixing masses of cancellous bone by wires or nails for the purpose of obtaining traction, when such can as effectually be obtained and maintained by the use of ice tong callipers that merely prick the cortical surface of the bone.

(*c*) Transverse and spiral fractures with complete overlapping are reduced by open operation: the bone ends engaged, the wound closed without internal fixation. If necessary, length is maintained by the subsequent application of ice tong calliper traction. Shortening with overlapping and angulation must at all costs be avoided.

> In the case then which we are now treating of, nothing should be omitted in order that the parts may be properly distended and put in a straight line, for it is a great disgrace and an injury to exhibit a shortened thigh. For the arm, if shortened, might be concealed, and the mistake would not be great: but a shortened thigh-bone would exhibit the man maimed. For when the sound limb is placed beside it, being longer than the other, it exposes the mistake, and therefore it would be to the advantage of a person who would be improperly treated that both his legs should be broken, rather than either of them: for in this case the one would be of the same length as the other.—Hippocrates.

But it is no uncommon thing for the two legs to be the same length when the patient first commences to walk, but for the fractured leg to shorten through bending under the body weight in a very gradual and insidious and heart-breaking manner during the next month or two, and this is all the more grievous a happening inasmuch as only too often by the time it is noticed and steps taken to remedy it, the bone has passed through the stage of "yielding callus" to the stage of "unyielding bone scar tissue"—the deformity is found to be incorrigible apart from osteotomy, refracture of the limb three to four months after the first fracture.

It should never for a moment be forgotten that fractures of the shaft of the femur in which there has been complete lateral displacement and overlapping, reach the stage of ability to withstand the body weight very late. In such, the first month of walking should be watched most carefully, even though the walking be done in a calliper.

Fractures Involving the Knee Joint.

In all fractures involving the articular surfaces of the three bones entering into the formation of the knee joint, two things are of paramount importance:

(*a*) The joint should be cleared of the blood effused into it, whether by aspiration or by open operation. Blood clot remaining in the cavity of the joint will organize: the joint will long remain thickened and hot, and the danger of partial ankylosis with the formation of adhesions is a real danger. For the same reason, all operations on the knee joint, whether for fracture or for other conditions, should be performed under a tourniquet and precautions should be taken at the end of the operation to prevent the joint filling up with blood after removal of the tourniquet. This can be done by a system of pads and bandaging which obliterate in advance and hold obliterated the various parts of the potential cavity of the joint.

(*b*) Displacement of portions of the articular surfaces should be dealt with by open operation, with a full exposure of the joint from the front. The fragment should be reduced absolutely and fixed absolutely by means of autogenous bone pegs. The integrity and smoothness of the articular outlines must be absolutely restored, otherwise the inevitable osteoarthritis occurs. Transverse fractures of the patella may be circumferentially wired.

Comminuted fractures of the patella or of the articular ends of the femur and tibia present serious problems. Often it is impossible completely to restore the articular surface of a badly comminuted upper end of tibia.

The writer is of opinion that a much better result can be obtained with greater freedom from osteoarthritis over a longer period of time in comminuted fractures of the patella with an unconquerable spreading of the fragments by immediate complete removal of the whole of the comminuted bone. If this be done at once, the quadriceps can from the beginning be kept in the high state of efficiency as a knee stabilizer; whereas if the operation be performed late in an attempt to stave off the development of osteoarthritis, it is likely that the efficiency of the quadriceps as a stabilizer is already reduced just when it has become more important than ever.

Fractures of the Shafts of the Tibia and Fibula.

Shortening is bad; but worse is shortening of the tibia in proportion to the fibula. Angulation is bad either way, but bending in the lateral plane is more serious in its effects than antero-posterior bending. Inward or outward rotation is very bad; it prevents the simultaneous flexion of the hinge joint above and the hinge joint below. The patient with an outward rotation of the lower fragment on the upper has either to walk with the foot turned out, which induces flat foot and *hallux rigidus*, or walk with a stiff knee. Lateral displacement in itself is alone of less functional significance, but much lateral displacement in transverse fractures means severe laceration of the periosteal sheath, and so a long drawn out process of union. Hence fractures with much displacement of the bones of the leg are not easy to treat.

(*a*) Subperiosteal fractures and fractures with little lateral displacement should be pulled straight and immobilized in a closely fitting plaster cast moulded round and above the knee and round the foot as far as the base of the toes.

(*b*) Spiral and oblique fractures in the upper two-thirds and transverse fractures with marked lateral displacement, but not completely overlapping, are best treated by powerful direct skeleton traction applied by means of a pin inserted above the *os calcis* in front of the *tendo Achillis*. The writer has a prejudice against thrusting a metal pin through the cancellous tissue of the *os calcis*, the introduction of infection into this bone being such a calamity.

(*c*) Fractures of the tibia alone, in which the bone angulates towards the intact fibula in a very obstinate and "ungetatable" sort of way, often require an incision with leverage of the bone to a straight line and its fixation by bone pegs.

(*d*) Spiral fractures of the lower third of the tibia, almost inevitably associated with fracture of the fibula high up, are most troublesome. These should be subjected to open operation early, before the soft parts become tough and indurated and inelastic. The tibia alone need be touched in these circumstances, the bones being angulated and levered into position, clamped by bone holding forceps, whilst holes are drilled in different directions, and the bones fixed internally by kangaroo tendon lashings or autogenous bone pegs. After such operation, union is often slow, and secondary late angulation must be carefully watched for. This is all the more necessary inasmuch as the commonest victims of this accident are very heavily built middle-aged women of anything from twelve to fifteen stone. It is just in the later phases of these cases that Delbet's walking plaster is of such great service.

Fractures Involving the Ankle Joint.

As a whole treatise could be written on fractures involving the ankle joint alone, the writer will try and summarize in brief "the leading motives".

1. Of first importance is it that the "fit" of the mortise be reconstituted at whatever cost; otherwise deformity, severe disability, in the ankle region iself with subsequent development of osteoarthritis, with secondary static disabilities of the foot itself, will inevitably result.

2. The foot must be set with a relation to the leg neither of equinus, varus nor valgus. In other words, the vertical axis of the posterior tarsal bones must be restored to a line continuous with the line of weight transmission down the leg, whilst full range of dorsiflexion of the ankle must be assured.

How are these indications to be fulfilled in the different types of fracture dislocation?

(*a*) In simple fractures of the lower end of the fibula without displacement, immobilize the fragments for two to three weeks in a well fitting plaster cast, with the foot fully dorsiflexed on the leg.

(*b*) In the ordinary Pott's fracture—fracture of the internal malleolus, associated with the fractured fibula—the posterior subluxation must be fully corrected and the outward displacement fully corrected by manipulation under anæsthesia. This outward displacement has two elements: bodily displacement of the foot outwards, as well as outward angulation of the vertical axis of the heel on that of the leg. Once this has been done, the reduction can be kept stable by simple pressure on the under surface of the balls of the toes, so as to lock the foot in full dorsiflexion with pressure inwards against the external malleolus so as to prevent resubluxation outwards; this whilst the plaster is being applied and until it is set.

(*c*) In bimalleolar fractures the lateral mobility is very extreme. Best results are obtained by open operation, exposing first the one malleolus and then the other, and fixing them to their respective shafts in absolute reposition by autogenous bone pegs.

(*d*) In Dupuytren's fracture where a laceration of the tibio-fibular ligaments with separation of the lower ends of both bones has occurred, as well as a fracture of the internal malleolus and of the lower end of fibula, early open operation is essential. The space between the bones should be cleared of callus, the bone surfaces stripped of the remains of the torn ligaments and the bone roughened, the two bones clamped into absolute apposition, and a transverse strong bone peg should be driven through both so as to induce a bony ankylosis. The internal malleolus may then be pegged on or not according as the remaining lateral mobility can be controlled by the hands or not.

(*e*) In Pott's fracture complicated by fracture and displacement of some portion of the articular surface of the tibia, early operation is essential. The portions liable to be so broken and displaced are three: (i) The anterior lip of the tibial end, which is displaced forwards and upwards. It must be brought down and pegged accurately in place. (ii) The posterior articular lip, which slips backwards and upwards. It, too, must be brought down and pegged. (iii) A triangular or wedge shaped portion split off from the part of the bone into which the tibio-fibular ligaments are attached. The wedge fragment remains attached to and displaced with the lower end of the fibula. The result is the same as in (*d*). It must be replaced and pegged absolutely in position.

In all of these open operations time is an important factor in making the operation easy or difficult. If two or three weeks are allowed to elapse, the displaced fragments become fixed in their new position, and it becomes a matter of the greatest difficulty to return them and fix them where they belong. This difficulty is not diminished by the finding that the masses of cancellous bone constituting the fragments have become cheesy in consistence.

Conclusion.

The writer feels that these notes are very scrappy and in many ways unsatisfactory, but if their dogmatic tone and somewhat revolutionary tendencies rouse interest, good: if they rouse opposition and controversy, better.

SURGICAL TREATMENT OF LUNG ABSCESS AND OF BRONCHIECTASIS.[1]

By L. A. Bennett,
Christchurch.

The efficient treatment of intrapulmonary suppuration depends on the following factors: firstly, a full conception of the physiology of the pleural and thoracic cavities; secondly, a recognition of the value of, and conversely the limitations of, medical treatment; thirdly, a clear idea of the pathological changes occurring in the lung when pus is present; and fourthly, localization of the focus of suppuration. In this discussion on treatment, however, it is not feasible to enter into these considerations in detail.

Physiological Principles.

It is sufficient to realize that, as regards physiological principles, an open pneumothorax is associated with a collapsed lung and a "flapping" mediastinum. Therefore, if gross soiling of the pleural cavity is to be avoided, any incision into a suppurating area in a lung, or even into a pleural cavity surrounding such a lung, must be preceded by fusion of the visceral and parietal layers of the pleura.

Medical Treatment.

Medical treatment has already been discussed by preceding speakers. The value of postural drainage, where communication with a bronchus exists, cannot be over-emphasized. Once operation has been performed, this method of emptying any residual cavity should again be employed as soon as the patient is capable of carrying it out, and continued until cough and sputum disappear. Failure of medical treatment must be accepted as one of the clearest indications for surgical operation.

Pathological Considerations.

Equally important is a clear idea of the pathology of intrapulmonary suppuration. Mr. J. E. H. Roberts, in his lectures, states that the generic term "abscess of the lung" covers a variety of conditions, including frank gangrene of the lung, multiple pyæmic abscesses, epithelial-lined cavities containing pus, so-called interlobar empyema, sterile collections of pus in bronchi distal to neoplasms, single circumscribed abscess cavities, and even localized bronchiectasis. To this list must be added suppuration following hydatid cysts, either primarily in the lung, or following transdiaphragmatic rupture of an infected cyst of the liver into an adherent lung.

Types of Condition Considered.

For the purpose of this discussion only two types of intrapulmonary suppuration will be considered:

1. Abscess of the lung which here includes a track or a solitary cavity in a lung lined by either granulation tissue, actual putrefying lung substance, or the adventitious fibrous wall which forms round a hydatid cyst. The essential point of this type is that, once efficient drainage is established, the walls of the cavity are capable of collapsing and healing by scar tissue.

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[1] Read at the Annual Meeting of the New Zealand Fellows of the Royal Australasian College of Surgeons, 1933.

2. True bronchiectasis, a condition in which dilatation of bronchi and bronchioles has occurred from any one of the known causes. The essential point in the pathology in this group is that, unless the condition is complicated by secondary abscess formation, the cavity is lined by epithelium. Even if collapse of the affected portion of the lung is produced and drainage to the exterior established, no repair by granulation can take place until all the epithelial lined dilatations have been excised. Profound differences in the treatment of the two types depend on these distinctions.

LOCALIZATION.

Exact localization of abscess cavities or of areas of bronchiectasis can be obtained only by X rays. Examinations by the fluoroscopic screen, as well as radiograms, are essential in all cases in which intrapulmonary suppuration is suspected. In the case of a solitary abscess, radiological examination without other aid is usually sufficient, but injection of lipiodol is necessary to determine the existence, site and extent of bronchiectasis. The screen examination indicates not only the presence of a "fluid level" in the abscess cavity, but also the position in which skiagrams will most advantageously demonstrate the depth of the abscess and the line of approach. When possible, the surgeon should witness this examination, but in any case radiograms from two directions, preferably at right angles, should be obtained. The value of bronchoscopy as an aid to localization has already been indicated by another speaker. Lastly, it may not be out of place here to condemn any attempts to localize abscess cavities by means of exploratory puncture with a needle. The risks of infecting the pleural cavity cannot be overemphasized. One case in this series (Case XIX), which fortunately did not end disastrously, is quoted in support of this contention.

INDICATIONS FOR SURGICAL OPERATION.

Generally speaking, the first treatment of intrapulmonary suppuration is medical or expectant in type.

In abscess of the lung, surgical measures are rendered necessary in the following circumstances:

(*a*) *Delayed Resolution.*—Certain types of abscesses apparently respond to postural drainage and appear to resolve steadily. Later, drainage becomes inefficient, as evidenced by a return of symptoms in the form of an almost incessant cough, with several ounces of foul sputum daily. A persistent fluid level in a cavity in the lung can be demonstrated by X rays (see Case VII, also Figures I, II, III and IV).

(*b*) *Progressive Deterioration.*—Progressive deterioration occurs in a patient with an abscess draining intermittently or not at all. In such a case there is cessation or absence of sputum, together with rigors or continued pyrexia and severe toxæmia (see Case VI, also Figures V, VI, VII, VIII and IX).

(*c*) *Chronic Abscess.*—Chronic abscesses are long standing abscesses previously undiagnosed or cavities following removal of suppurating hydatid cysts. In them there may be a set of symptoms very similar to those of a localized bronchiectasis (see Case IX, also Figure X).

In bronchiectasis the indications are less well defined. The condition should be confined to one lobe, or a portion of a lobe, and preferably unilateral (if such a state ever exists), or predominantly affecting one lung. The age and general condition of the patient are also important factors in settling the question of operation. In suitable cases the supreme discomfort consequent on the expectoration night and day of large quantities of fœtid sputum is the only clear indication in an uncomplicated case (see Case XX, also Figure XI).

The Time to Operate.

The most important decision is when should operation be performed. Various authorities lay down arbitrary periods during which medical measures

may be employed with the hope of resolution of an abscess. It is now generally accepted, however, that bronchial drainage should be tried for at least two months. If steady improvement is not then taking place, surgical operation must be

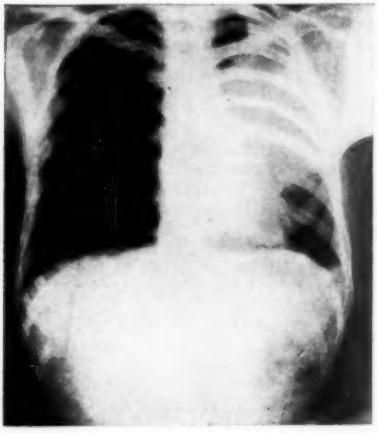


FIGURE I. Case VII. Early stage of abscess of lung.

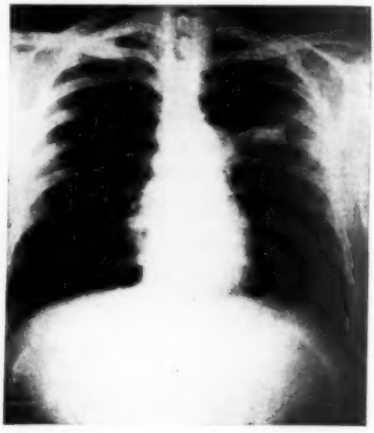


FIGURE II. Case VII. One week later. Resolution apparently occurring.

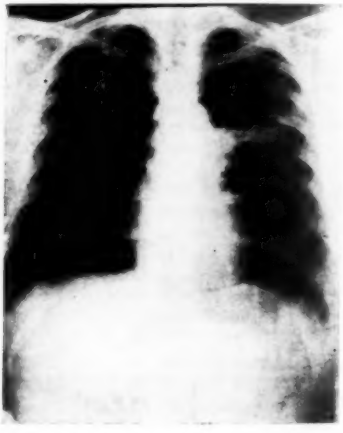


FIGURE III. Case VII. Two months later. Cavity with fluid level developed.

FIGURE IV. Case VII. Wound ten days after two-stage drainage of abscess. Bronchial openings visible.

considered. The general condition of the patient, the quantity and character of the sputum, the degree of clubbing of the fingers (if present), and alteration of the X ray appearances are important factors in making this decision. In

uncomplicated bronchiectasis, bronchial drainage can only be a palliative measure, and the time for surgical interference therefore depends on the degree of discomfort and the general health of the patient.

Urgent Indications.

Urgent surgical attack is demanded by rupture of an abscess into a free pleural cavity with a resultant empyema or stinking pyo-pneumothorax, often of the tension type. Similarly early operation is necessary when rapid extension of the putrefactive process from lack of drainage and consequent pressure of pus gives rise to advancing gangrene of the lung (see Case XVII).

METHODS OF TREATMENT.

1. Prophylaxis has already been considered by other speakers, as also have medical treatment and bronchoscopic drainage.

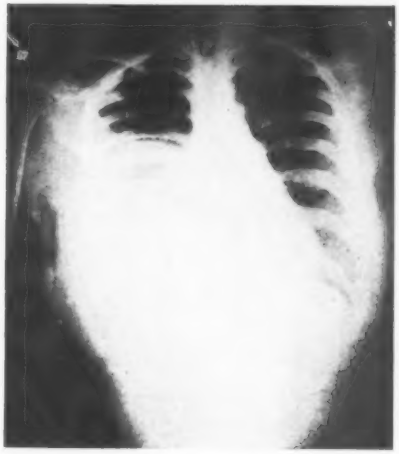


FIGURE V. Case VI. Abscess of lung showing fluid level. Inefficient drainage.

FIGURE VI. Case VI. Lateral view of abscess.

2. Artificial pneumothorax is noted only in passing because of a personal disaster in one case. Theoretically, it would seem to be ideal to bring about collapse of a lung while an abscess healed. In practice, however, such a measure is indicated only in certain deep abscesses close to the hilum and communicating with the large bronchus. In more superficial abscesses collapse of the lung may lead to rupture of the abscess into the pleural cavity with a resultant highly dangerous pyo-pneumothorax (see Case I).

3. Operative measures. A distinction here must be made between the two types of pathological change mentioned earlier. In lung abscess removal of a circular piece of lung to allow external drainage is usually sufficient, whereas in bronchiectasis removal of the whole or a portion of a lobe is necessary to allow of cure.

The various operative procedures are: (*a*) external drainage, (*b*) partial cautery lobectomy, (*c*) lobectomy, (*d*) avulsion of the phrenic nerve, (*e*) extrapleural thoracoplasty.

External Drainage.

Wherever possible, external drainage should be carried out under local anæsthesia. This is administered by a paravertebral block over at least three or four intercostal nerves, combined with regional infiltration, in order to prevent painful sensations when portions of the large thoracic muscles are being removed.

In nervous patients, gas, oxygen and ether may be used, unless the actual cautery or the endotherm knife is to be employed, in which case chloroform must be administered.

The area of affected lung must be carefully localized and the approach planned according to the site. The best approach to upper lobe abscesses is an anterior one or through the anterior part of the axilla. Middle lobe conditions are usually reached antero-laterally, while basal or lower lobe abscesses are most readily drained posteriorly or postero-laterally.

FIGURE VII. Case VI. Drainage ceased, abscess full. Patient acutely ill with severe toxæmia.

FIGURE VIII. Case VI. After two-stage external drainage. Tube into cavity shown.

Technique.

If the abscess cavity communicates with a bronchus, as much discharge as possible is removed by postural drainage shortly before the operation, which should be carried out in two or more stages. The first stage aims at fixation of the lung to the chest wall by the formation of adhesions between the visceral and parietal layers of the pleura. The second and any subsequent stages are to obtain drainage or to remove portions of lung tissue.

Under the selected anæsthesia an incision through skin and muscles is made over the site of the abscess, exposing ribs and intercostal muscles. An extension at right angles is often advisable to allow reflection of two triangular flaps. Portions of the large thoracic muscles are next removed over a sufficiently wide area to expose several inches of two ribs at least, or more, according to the size of the abscess. There appear to be no detrimental effects resulting from excision of portions of the *serratus magnus, latissimus dorsi* or pectoral muscles, and subsequent treatment of the lung is facilitated by this means.

Up to ten centimetres (four inches) of each rib are now excised subperiosteally. It will then be found that the corresponding intercostal muscles, neuro-vascular bundles and deep layer of periosteum can with care be stripped from the underlying tissues. They are removed, a more or less rectangular area

of parietal pleura being laid bare. In doing this, too much stress cannot be laid on the need for taking the greatest care to avoid perforation of this membrane. The preservation of an intact parietal pleura is one of the most important points in this stage of the operation. The appearances at this point vary. If the two layers of the pleura are already adherent, the parietal layer may be thickened and œdematous. On the other hand, a thin translucent membrane under which a non-adherent lung is moving freely, may present itself.

In either case, adhesions are produced or increased as follows. A very fine hypodermic needle is inserted through the intact pleura and a few drops of tincture of iodine are injected between the contiguous layers of the pleura. The outer surface of the parietal pleura is liberally painted with the same fluid. Finally, the cavity is packed firmly with gauze soaked in tincture of iodine, and this step of the operation is closed with the suture of the skin incision.

FIGURE IX. Case VI. Final condition of lung.

FIGURE X. Case IX. Chronic abscess cavity following removal of suppurating hydatid cyst four and a half years previously.

Usually, at the end of seven to ten days, firm adhesions will exist.

Under suitable anæsthesia the wound is reopened and the packing removed. If firm adhesions have formed, the field is clear for the second stage, and the lung is now explored with a long needle attached to an aspirating syringe. It is important to realize that, although the needle has entered the cavity, no pus may be obtained on aspiration, the syringe appearing sometimes to withdraw air only, or at most blood-stained fluid. The needle is left *in situ* and the contents of the syringe are expelled close to the operator's nose. Foul-smelling gas may be the only thing noted, and is evidence that the needle has entered the cavity. Similarly, the blood-stained fluid may possess the characteristic foul odour of breaking-down lung.

Once pus or other evidence of the abscess is found, an incision is made through the fused layers of the pleura into the lung, and deepened along the line of the needle until the cavity is reached. In this series of cases the endotherm knife has been used for the purpose, but a scalpel or the actual cautery may be

employed if preferred. A circular piece of the lung forming the outer wall of the abscess is now removed. Bleeding may be profuse, but owing to the low pressure in the pulmonary vessels, it is easily controlled by a large moist swab till the application of a coagulating diathermy electrode to the bleeding points arrests the hæmorrhage. It may be necessary to excise a considerable portion of a lobe before the operator's objective is reached and the cavity opened out in the form of a wide-mouthed cup.

Sufficient skin and muscles are now removed to do away with overhanging walls, and the cavity is filled with gauze lightly packed round a wide tube. The use of the last is a matter of opinion, but a tube has been found to be of value in some cases. The skin incision is left open.

FIGURE XI. Case XX. Lipiodol in bronchiectasis at base of left lung. (This picture has been reversed in the reproduction; the bronchiectasis is at the left base.)

FIGURE XII. Case XX. Final condition of lung after partial cautery lobectomy and phrenic avulsion.

Modifications of this procedure may be necessary in suppuration following hydatid cysts. In the case of an infected cavity following rupture of a cyst primarily in the lung, a similar but more extensive operation is indicated.

Where the suppurating cyst has originally been in the liver, and a fistulous track exists between that organ and the lung, the intrapulmonary cavity is opened as described. A dumb-bell shaped abscess is usually present. After dilatation of the track connecting the two terminal expansions and removal of any cyst remains, a large tube is inserted through the diaphragm into the liver, and the abscess is allowed to heal by granulation.

After-Treatment.

In spite of the severity and often prolonged nature of these manipulations, there is surprisingly little post-operative shock, probably due to the fact that the lung is anæsthetic. After-treatment consists in placing the patient so that the external opening of the cavity is most dependent. Dressings are changed as required. After a day or two the offensive nature of the discharge from the disintegrating lung may render several changes necessary every day. The cavity

should be kept open by packing till the discharge decreases very markedly. The pain of changing the dressings may be much lessened if the skin edges are thickly smeared with sterile vaseline before the packing is reinserted.

As the wound cleans, a pink granulating floor develops in which numerous bronchial openings may be visible, and in adequately drained cases rapid general improvement and local healing are the rule. Even after extensive cavities have been opened, the ultimate result leaves little deformity.

During convalescence postural drainage should be continued if there be much sputum. In toxic cases where there is much infection with organisms of the spirillum group, exhibition of arsenic compounds is indicated.

Partial Cautery Lobectomy.

Partial cautery lobectomy is the procedure of choice in cases of bronchiectasis suitable for surgery, and is carried out by a multi-stage operation. Up to the commencement of the second stage, the procedure is similar to that already described above under external drainage.

It is not uncommon to find at the second stage on incising the parietal pleura, that, although firm adhesions apparently exist, they may be of the filmy type, only sufficient to prevent the lung from collapsing, but precluding any incision into the suppurating focus. In such a case, the wound is repacked with iodine-soaked gauze, some of which is actually inserted gently into the pleural cavity. The wound is again closed for five to seven days.

At the subsequent operation the lung and overlying layers of the pleura are incised with an endotherm knife and the wound is deepened until the epithelial-lined cavity is reached. The surrounding lung is then excised piecemeal until there presents a large basin-like cavity into which several dilated bronchi open. Hæmorrhage is even more profuse than in abscess cases, but is easily controlled by pressure and arrested by diathermy coagulation. Light packing of the cavity with gauze completes the operation.

Subsequent similar piecemeal removal of portions of the lung is carried out till the whole of the affected area has been excised. The cavity is then allowed to granulate. If preferred, the removal of the lung tissue may be performed with the actual cautery in the form of red hot soldering irons, as employed by Graham and others. The after-treatment is the same as for external drainage of an abscess of the lung. A bronchial fistula may develop ultimately and necessitate a further operation for its closure.

Lobectomy.

Actual removal of a lobe of a lung is a formidable procedure, and has not been attempted in any case. Beyond stating that even in the most capable and expert hands the mortality is high, and that the operation is indicated only in certain rare cases of bronchiectasis in young and vigorous patients, this operation will not be discussed.

Avulsion of the Phrenic Nerve.

There appear to be four indications in intrapulmonary suppuration for avulsion of the phrenic nerve. They are:

1. As a curative measure in certain basal abscesses where the collapse of the walls resultant on the rise of the diaphragm and the improvement in bronchial drainage allow the abscess to heal. No case of this type has occurred in this series.

2. As a palliative measure in basal bronchiectasis. In some cases the compression of the lung following the operation is claimed to lead to marked diminution of the sputum and consequent comfort to the patient. The procedure, in view of the condition of the bronchial walls, is a method of doubtful value. The results in three cases, in all of which the patients obtained initial benefit, are now most disappointing (see Cases XV, XVI and XVIII). The first and second patients, after two and two and a half years respectively, are almost

as uncomfortable as before the operation. The third, after eighteen months, has still definite diminution in the amount of sputum, but is subject to acute exacerbation at intervals.

3. As a prophylactic against secondary bronchiectasis. In some cases fibrosis, following external drainage of a basal abscess, may lead to traction bronchiectasis in the remaining portion of the lung. The effect of a paralysed diaphragm on this more or less useless portion of the lung is twofold: relief of traction on the one hand and improved collapse on the other. Both of these effects should serve to prevent dilatation of the remaining bronchi. There is much controversy over the propriety of these views. Phrenic avulsion has, however, been carried out in two cases of this series with the object of preventing development of bronchiectasis after drainage of an abscess (see Cases VIII and IX). One patient has no cough or sputum two years and eight months after the operation and the second is free from sputum after more than two years.

4. As a subsidiary measure in cautery lobectomy. After removal of a portion of a lobe, the size of the granulating cavity is reduced by the rise of the diaphragm consequent on its hemi-paralysis. The avulsion should follow the main operation, otherwise the normal relationships are altered, localization being rendered more difficult.

Technique.

The operation is performed under local anæsthesia. A transverse incision about 3·75 centimetres (one and a half inches) in length, commencing at the posterior border of the sterno-mastoid muscle, is made about 3·75 centimetres (one and a half inches) above and parallel to the clavicle. After division of the skin and platysma, the posterior border of the sterno-mastoid muscle is defined as is also the deeper omo-hyoid muscle. By blunt dissection through a mass of fatty tissue, deep to this muscle the anterior surface of the *scalenus anticus* is exposed. On this, beneath a layer of fascia, the phrenic nerve is found passing downwards and inwards. The nerve is gently cleaned and after injection of a few drops of "Novocain" it is raised and divided. The lower end is then grasped in a pair of artery forceps, and the nerve is slowly twisted out. The gradual nature of the withdrawal is the most important point, and several minutes should be spent on it. At least 7·5 to 10·0 centimetres (three to four inches) of the nerve must be removed if the communications usually present between the phrenic nerve and the nerve to the subclavius muscle and other accessory phrenic nerves are to be divided. Failure to rupture these connexions may mean only partial or temporary paralysis of the corresponding half of the diaphragm. After removal, a few skin stitches and application of a collodion dressing complete the operation.

Thoracoplasty.

Partial thoracoplasty is a natural result of every extensive operation on an abscess of the lung, for portions of several ribs are removed. As a consequence, part of the chest wall collapses in the course of the cure.

Total extrapleural paravertebral thoracoplasty was formerly considered to be indicated in certain cases of widespread bronchiectasis mainly confined to one lung. In view of the pathological consideration that the dilated bronchi are lined with a secreting epithelium, this must obviously be a doubtful and even potentially dangerous procedure. In one case in this series, a multi-stage thoracoplasty was commenced, but the patient succumbed to a cerebral abscess before the treatment could be completed. At *post mortem* examination the state of the affected lung showed the procedure to have been of little or no value (see Case XIV).

In intrapulmonary suppuration there is, however, one clear indication for a total thoracoplasty. Following rupture of a lung abscess into a free pleural cavity, a pyo-pneumothorax may have to be drained for a long period, the corresponding lung being left completely fibrosed and irrevocably collapsed. A chronic suppurating cavity will then exist in one half of the thorax. In such a case the operation may be performed with considerable benefit to the patient.

The operation is performed in two or more stages. In very debilitated patients the earlier operations are confined, if necessary, to removal of one rib

only at a time. The technique will not be considered here, for, if it be conceded that the operation is indicated only in what should be a rare complication of lung abscess, further description has no place in this discussion.

The same considerations preclude more than a mention of cerebral abscess as a complication of intrapulmonary suppuration. The incidence in this series of cases, namely 10%, seems high.

Brief notes of the cases on which this paper is based follow.

NOTES ON CASES.

Abscess of Lung.

CASE I.—J.C., a male, aged sixty years, suffered from an abscess of the lower lobe of the right lung following inhalation of a fish bone. Artificial pneumothorax was induced. Rupture of abscess into pleura occurred. Pyo-pneumothorax resulted. Drainage was established. The patient died.

CASE II.—M.N.F., a female, aged thirty-seven years, had an abscess in the middle lobe of the right lung following influenza and pneumonia. Rupture occurred into a large bronchus. Postural drainage was adopted. Spontaneous recovery occurred.

CASE III.—J.M., a male, aged sixty-four years, had a large abscess of the lower lobe of the right lung following partial gastrectomy for carcinoma of the stomach. Death occurred. Diagnosis was made only at *post mortem* examination.

CASE IV.—A.S., a male, aged forty-six years, had a large abscess of the lower lobe of the right lung following partial gastrectomy for chronic gastric ulcer. Rupture occurred into a bronchus. Postural drainage was adopted. Spontaneous recovery occurred.

CASE V.—W.J.W., a male, aged fifty-two years, was admitted to hospital in January, 1930, with severe cough and offensive sputum. His condition was diagnosed as pulmonary tuberculosis; he was transferred to a sanatorium. He was readmitted in October, 1930, under my care with a large amount of offensive sputum and signs of right-sided hemiplegia. A diagnosis of cerebral abscess complicating an abscess of the lung was made. Death occurred. *Post mortem* examination revealed an abscess of the upper lobe of the right lung and a large abscess of the left occipital lobe of the brain.

CASE VI.—M.G., a female, aged thirty-seven years, had an abscess of the lower lobe of the right lung, following injury to the chest wall. Rupture occurred into a small bronchus. Postural drainage and bronchoscopy failed. Two-stage external drainage and partial lobectomy were adopted. Recovery followed.

CASE VII.—J.C., a male, aged twenty-one years, had an abscess of the left upper lobe following pneumonia. He appeared to improve with postural drainage and was discharged from hospital. He was readmitted with delayed resolution of the abscess. Two-stage external drainage was used. Recovery followed.

Abscess of the Lung Following Hydatid Cyst.

Primarily in the Lung.

CASE VIII.—L.N., a male, aged thirty-one years, had his chest explored in another hospital for fluid. A hydatid of the lung ruptured. Immediate one-stage operation for removal was performed. He was admitted to hospital later under my care with his right lung collapsed and fibrosis and an abscess of the lower lobe of the right lung draining into a bronchus. External drainage, avulsion of phrenic nerve, partial thoracoplasty were used. Recovery followed.

CASE IX.—M.W., a female, aged thirty-nine years, was admitted to hospital four and a half years after removal of a hydatid cyst from the middle lobe of the right lung. There was a large abscess in the site of the old cyst surrounded by an area of secondary bronchiectasis. A four-stage operation of external drainage and extensive partial cautery lobectomy was performed; the right phrenic nerve was avulsed. Recovery followed.

CASE X.—E.T., a female, aged thirty-one years, was admitted to hospital three and a half years after rupture of a hydatid cyst in the lower lobe of the right lung. She had an abscess in the lung and daughter cysts in the mediastinum. One-stage external drainage and removal of cysts were performed. It is not known whether the patient recovered.

CASE XI.—P.R., a male, aged twenty-nine years, was admitted to hospital twelve years after removal of a hydatid cyst from the lower lobe of the right lung. He had a large suppurating cavity in the right lower lobe complicated by bronchial fistula. He refused partial lobectomy. Avulsion right phrenic nerve was carried out. No improvement followed.

Primarily in the Liver.

CASE XII.—A.F., a female, aged forty-one years, had a large hydatid cyst of the left lobe of the liver removed. Three months later a suppurating subdiaphragmatic cyst of the right lobe of the liver was removed. Subsequent to operation an abscess developed in the right lobe of the liver, and the lower lobe of the right lung, associated with another cyst. One-stage drainage of abscess and removal of hydatid were carried out. Recovery followed.

CASE XIII.—M.A., a female, aged forty-six years, had jaundice in 1921. At operation a large suppurating hydatid cyst of the upper surface of the right lobe of the liver was removed. In 1922 the gall-bladder was drained for jaundice. In 1930 the common duct was explored for jaundice. In 1931 the patient was coughing up bile and pus. X ray examination suggested well marked adhesions of the lower lobe of the right lung to the chest wall. The thorax was explored. No adhesions were found. Collapse of the right lung followed. The cavity was packed with iodine-soaked gauze. A second operation was performed fourteen days later. Well marked adhesions were present. External drainage of abscess was undertaken. Recovery followed.

Bronchiectasis.

CASE XIV.—W.M., a male, aged fifty-two years, had bronchiectasis with a secondary abscess of the lower lobe of the right lung following an operation for diverticulum of the bladder. Avulsion of phrenic nerve was performed with doubtful improvement. Total thoracoplasty in stages was commenced. Treatment was interrupted by the development of a cerebral abscess. Death occurred. *Post mortem* examination showed two abscesses in the left occipital lobe of the brain and extensive bronchiectasis with secondary abscess formation of the right lower lobe of the lung.

CASE XV.—K.C., a female, aged seventeen years, was in a sanatorium for eleven years with bilateral basal bronchiectasis. The origin of the condition was unknown. Avulsion of the left phrenic nerve was performed. Sputum was reduced in amount. The patient stated that she had improved.

CASE XVI.—F.K., a male, aged fifty-five years, had bilateral basal bronchiectasis, more marked on the left side, following pneumonia and empyema thirty years previously. Avulsion of the left phrenic nerve was performed. The sputum was reduced in amount. The patient stated that there was slight improvement.

CASE XVII.—C.B., a male, aged twenty-four years, had bronchiectasis of the right middle lobe following whooping cough eighteen years previously. There was secondary abscess formation. Gangrene of lung occurred. Death followed.

CASE XVIII.—V.L., a male, aged thirty-one years, had bilateral bronchiectasis, predominantly right sided, following bronchopneumonia twenty years previously. Avulsion of the right phrenic nerve was performed. Sputum was much reduced in amount at first. Recently he has had bouts of pyrexia and increase of sputum. No improvement has taken place.

CASE XIX.—D.S., a male, aged nineteen years, had bilateral bronchiectasis and ozena following removal of tonsils and adenoids eleven years previously.

He had a secondary abscess formation of the left lung. His own doctor explored his chest with an aspirating needle. He obtained blood at first and then clear fluid as the needle was withdrawn. Four days later, stinking empyema (localized) developed. One-stage drainage of empyema and lung abscess was undertaken. Recovery followed.

CASE XX.—E.O., a female, aged forty-seven years, had bronchiectasis of the left lower lobe following abscess of the lung due to aspiration of a tooth eight years previously. Up to thirty ounces of foul sputum daily were expectorated. Avulsion of the phrenic nerve was performed. Partial cautery lobectomy in four stages was performed with an endotherm knife. Recovery followed. Now the patient has no sputum.

SUMMARY.

1. The physiology of the pleural cavity, medical treatment, pathological changes and localization of cavities in the lung are considered very briefly, in so far as they influence surgical treatment of intrapulmonary suppuration.

2. The indications for surgical measures in abscess of the lung and bronchiectasis are discussed.

3. The operative procedures in general use are considered, with details of surgical technique of the operations of external drainage of abscess of the lung, partial cautery lobectomy and phrenic avulsion.

CONCLUSIONS.

1. Circumscribed abscess of the lung is eminently suitable for surgical treatment when adequate medical and bronchoscopic drainage have failed to cure the condition. Good results follow the operation of choice, namely, a two-stage external drainage. Phrenic avulsion as a prophylaxis against secondary bronchiectasis may be subsequently advisable.

2. Localized bronchiectasis may be treated by surgical measures in selected cases. An operation which gives good results is partial cautery lobectomy by the endotherm knife, carried out in several stages. Phrenic avulsion is of definite value as a subsidiary measure.

ACKNOWLEDGEMENTS.

My thanks are due to Dr. R. Neil Guthrie for valuable help in the radiological problems involved in the treatment of these cases, and also to Sir Hugh Acland for permission to include four cases in which the operations were carried out by us both in collaboration.

Case Reports.

ADVANCED CARDIOSPASM.

By Casement Aickin, J. Hardie Neil and Douglas Robb,
Auckland.

Only a small percentage of cases of cardiospasm in these days requires more than periodic dilatation of the orifice from above. The use of the rubber tube filled with mercury (Hurst), the hydrostatic dilating bag of Plummer, the Tucker bag distended with air, and ordinary bougies, with the help of endoscopy, enables most of these patients to be kept comfortable and in good health. This small percentage is variously estimated. Lamson[1] gives it as 5%. The Mayo Clinic[2] reports three cases only in the last 700, or 0·4%. Walton,[3] while not giving a percentage of all cases of cardiospasm, apparently uses a major method more commonly, as he describes sixteen cases treated by dilatation from below.

The difficulties encountered in the dilatation of the sphincter from above are: (i) Difficulty in locating and passing the upper end of the obstruction, even with the help of endoscopy or X rays. (ii) Unsatisfactory relief even when satisfactory dilatation has been repeatedly carried out. This occurs chiefly in the very long-standing cases in which trouble has been present for many years. The difficulty is a mechanical one. The gullet is not only dilated, but lengthened and tortuous, and a large pouch can be seen on X ray examination lying behind the diaphragm and to the right of the cardiac orifice. In this pouch *débris* collects and fails to pass onwards, even when the orifice is well dilated. The redundant lining of the pouch and its wide extent to the right make the discovery of the orifice difficult.

Types of Treatment Adopted.

The measures carried out in the past for the relief of this small group of cases are varied, but can be grouped as follows:

1. *Œsophagoplication.*—Freeman[4] in 1923 reported a case in which operation had been performed twenty years before with permanent relief. He exposed the gullet on the left side of the neck, and found that the dilated and lengthened organ could easily be pulled up from the mediastinum, and its length reduced by making an intussusception. Although there is no record of this procedure having been repeated, it seems reasonable and calculated to succeed if combined with the usual dilatation of the cardiac orifice from above.

2. *Dilatation of the Orifice from Within the Stomach.*—This is the favourite procedure and resembles Loretta's operation for the pyloric stenosis of infants. Mikulicz in 1882 and 1904 described his method, using rubber-covered forceps, the blades being separated until six to seven centimetres lay between them. Some patients were lost through rupture of the gullet wall and mediastinitis. Erdman in 1906, Walton in 1925,[3] and Judd and Vinson in 1929,[2] described digital dilatation, with the hand in the stomach cavity, until one, two, three or four fingers pass into the œsophagus. The results of this operation appear to be good. It is safe when the dilatation is done with the fingers, but although a good

opening is made between stomach and gullet, the pouch of œsophagus referred to above does not necessarily drain well.

3. *Extramucous Cardioplasty.*—Extramucous cardioplasty resembles Rammstedt's well-known procedure on the pylorus. Heller in 1914, quoted by Hurst,[5] and Lamson[1] achieved good results without mortality in 12 out of 16 cases. The sphincter is not found thickened or hypertrophied as in the pyloric condition of infants. The operation is open to the objection, though possibly to a less extent, given under 2 (digital dilatation), namely, that there is no direct treatment to the œsophageal pouch.

4. *Œsophago-Gastrostomy.*—The making of an anastomosis between the dilated part of the œsophagus and the cardiac end of the stomach has been described by Herovsky (quoted by Lamson), Exner (quoted by Hurst), Enderlin, Finsterer, Sauerbruch, Grey Turner,[6] Lamson and Keller.[7] Details of the execution of this operation vary in different accounts, and are probably dictated by the circumstances found on each occasion. The operation is tedious, difficult, and not without danger, and one which should not be under-estimated. Nevertheless, it seems to be the only procedure suitable for a case of long duration with a large œsophageal pouch which drains badly.

In the case about to be described, the operation of œsophago-gastrostomy was decided upon because the lower end of the gullet did not empty satisfactorily even after a prolonged dilatation of the orifice.

Case Report.

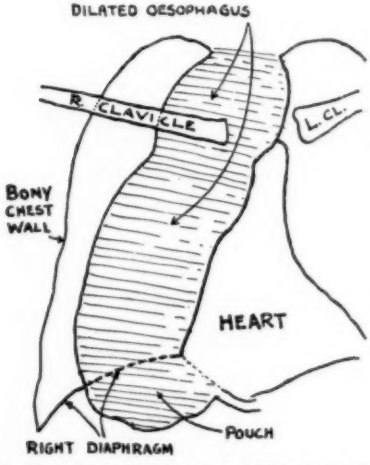
The patient was a man of fifty-two years, a member of the Hebrew race in comfortable circumstances.

Since the age of eighteen years the patient had never known what it was to enjoy his food. Swallowing was easy, but it was invariably followed by a loaded feeling in the chest, and a sensation of pressure was constant for a period of an hour or longer. He was able in general to eat all foods, but frequently had to take a mouthful of water, and exert expiratory pressure while holding his breath, to diminish the feeling of fullness. After a meal, such as dinner, he was forced to retire and irritate the throat in order to set up vomiting. On lying down at night he invariably had a tickling in the throat due to œsophageal contents running up to the lower end of the pharynx. On going to sleep he was wakened with a choking sensation, and had to go at once to vomit. Apples, oranges and bananas were very irritating. The ejecta were pulpy, and the constituents were easily recognizable. Sometimes a substance such as corned beef taken the day before would be recognized. The lower end of the sternum was apparently the site of the obstruction. A deep breath would cause discomfort located in the back at the level of the lower part of the shoulder blades. From the age of eighteen the symptoms gradually became constant. He was a healthy, active boy. His weight never varied, but at about eighteen he remembers a severe attack of pain that was thought to be indigestion. He had marked constipation, and was examined by X rays for bowel obstruction.

Treatment.—No treatment was applied until thirteen years ago, when the discomfort became so marked that he consulted a doctor, who suggested relief by the stomach tube. This was carried out until irritation of the throat prevented its being continued. He then practised induced vomiting to get relief. He came to Auckland about 1922, and on examination with the endoscope a mass of cheesy matter seemed to fill a very dilated gullet. He was submitted to X ray examination in Christchurch by Dr. Neil Guthrie, and the diagnosis of cardiospasm was confirmed. He went to England for advice. He was examined there and treated endoscopically with some relief for about six months. On his return to New Zealand he consulted one of us (J.H.N.). He felt that he was going downhill and losing weight rapidly. He was sallow and weighed just over 61·2 kilograms (nine stone ten pounds). He had put on weight during the sea voyage.

At this stage, December, 1931, the gullet was seen to be macerated in the lower half. At the fundus of the dilatation were granulations that bled so easily

that malignant disease was at once thought of. He was referred to one of us (C.A.), who concurred in the immediate necessity for gastrostomy. This was done on December 10, 1931, and the stomach was found to be very small. A stout silk thread was passed up the gullet and through the nose, and the ends were tied. He was given gullet lavage for about a month until the return wash contained only mucus and some light *débris*. During this time he was fed only by the gastrostomy tube, and about twice a week dilatation with Tucker's retrograde rubber bougie dilators was carried out; three of the largest size of these tied together encountered no resistance other than that of the gastrostomy orifice. On attempting to feed him again by the mouth, it was obvious from the X ray films and screening of Dr. Bruce Mackenzie that there was no free entrance of food into the stomach. It was apparent that further treatment would be necessary, although by this time the mucous membrane of the gullet was seen to be greatly improved and free from excoriation. Operation was advised and carried out by C.A., with the assistance of D.R.



Tracing from film taken in 1923, showing œsophagus greatly dilated in its whole length, extending far over into the right side of the chest, and the pouch at the lower end extending a considerable distance below and behind the diaphragm on the right side. The latest film (1933), taken twenty months after operation, is not suitable for reproduction, but shows the œsophagus reduced to two-thirds of this width, and the pouch, while still present, appears half this size.

Operation.—High spinal anæsthesia was induced to the level of the third thoracic segment by means of "Percaine", and this produced a most satisfactory relaxation of the abdominal muscles. Light general anæsthesia was induced also, and was deepened at the later stages when the effects of the spinal anæsthetic were commencing to wear off.

Through a paramedian incision on the left side, the cardiac end of the stomach was exposed and loosened from its diaphragmatic attachments. By passing a finger through the œsophageal opening of the diaphragm, the œsophagus was freed and drawn down for about 5·0 centimetres (two inches), a definite portion of the pouch above the constricted cardia being brought into view. At this stage the œsophagoscope was passed, and it was demonstrated that no undue slack was left above the diaphragm, and the gullet was cleared by suction. An anastomosis was then made between the œsophageal pouch and the cardiac end of the stomach by the customary two layers of sutures. The left vagus nerve did not come into the field of operation. While the œsophageal opening of the diaphragm was stretched and rendered patent by the finger passed into the mediastinum, sudden respiratory embarrassment, followed immediately by swelling of the neck and face, was caused by the suction of air into the mediastinum with each inspiration. The dyspnœa was speedily relieved on removing the finger and allowing the opening to become airtight, but the surgical emphysema became diffused in the subcutaneous tissues of the neck, face and trunk, and took many days to disappear. The large gastrostomy opening which had been freed from the abdominal wall to permit free access to the cardiac end during the operation, was closed in part, sufficient opening for feeding being left through a small tube; and the stomach was reattached to the parietal peritoneum. A small drainage tube was introduced under the diaphragm, and the abdominal wound was closed.

Progress.—The patient was an ill man for some days after the operation. The contents of the œsophagus were aspirated by suction every day for about a week, and feeding was commenced by mouth after that time. A basal pneumonia of short duration also occurred. After the second week progress was steady.

Two months after the operation Dr. Bruce Mackenzie reported as follows on the screening:

> The liquid meal is observed to pass through the œsophagus fairly rapidly into the stomach. The œsophagus still sags down on the right side behind the dome of the diaphragm. The stomach is small, but is larger than at the previous examinations. Vigorous peristalsis is observed.

The patient at this stage had put on weight and was enjoying life. He could eat all articles of diet with enjoyment.

Twenty months after operation the patient reported himself as very well. Increased weight had been maintained, and there were no symptoms whatever related to swallowing or digestion. X ray screening showed reduction in size of gullet and pouch (see reading under diagram).

Note on Dilatation in Cardiospasm.

(J.H.N.).

It may be noted that three full size Tucker retrograde rubber bougies (1·2 centimetres in diameter each) tied together simply slipped through the orifice into the gullet. The bag of the Tucker's pneumatic dilator as supplied by the makers, when dilated at fifteen pounds to the inch, measured barely 2·5 centimetres (an inch) across. We had a dilator cover made of calico twill which when dilated at fifteen pounds measured just over 3·75 centimetres (an inch and a half). The inside of the bag was dusted with white lead to make it visible under the screen. F. J. Gwynne screened the passage of the bag and noted when it was gripped and indented by the obstruction. Mosher,[5] who has made several valuable contributions to the study of the gullet and cardiospasm, states that he seldom uses more than three pounds pressure. In a case of cardiospasm that followed a gall-bladder infection we got no result until we used the large dilating bag at fifteen pounds for fifteen minutes. It was evidently one of those cases of fibrosis of the terminal portion of the œsophagus. Mosher also gives some interesting points as to surgical access to the region. He records one case in which a "surprising exposure" was obtained after phrenicectomy on the left side and turning the left lobe of the liver upwards and to the right. It occurs to us that a temporary palsy of the phrenic nerve by injection of absolute alcohol might be more suitable than a final destruction.

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[3] A. J. Walton: "The Surgical Treatment of Cardiospasm", *The British Journal of Surgery*, Volume xii, April, 1925, page 701.

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CONJUNCTIVAL DERMOID.

By W. A. FAIRCLOUGH,
Honorary Ophthalmic Surgeon, Auckland Hospital.

FOR many years past it has been recognized that amnion bands and ovial membranes or ligaments exercise a definite influence on the development of the

FIGURE I. Showing conjunctival dermoids.

human fœtus. Fingers, toes and even complete limbs have been strangulated *in utero* through their agency.

It is comparatively lately that D. Van Duyse, Professor of Pathology and Ophthalmology in Gand, put forward the idea that ovial membranes caused various congenital malformations of the face.

Professor J. Van Der Hoeve, of Leyden,[1] has submitted evidence that such congenital deformities as protuberances before the ear, macrostomia, coloboma of the mouth, coloboma of the eyelid, dermoids and leucomata of the eye, open facial fissures, and divided lachrymal pathways, are possible sequences of the influence of ovial tissue on the human face. Subsequent discussion on Van Der Hoeve's remarks showed that his ideas were not accepted *in toto*.

Ocular dermoids are always congenital, and they are frequently associated with some other facial defect, such as coloboma of the eyelid, abnormality of the lachrymal apparatus, macrostomia, preauricular tags, or a misshapen pinna. In

FIGURE II. Showing deformed pinna.

the rarest form,[2] cryptophthalmus, as the eyelids fail to bud during embryonic life, the surface of the eye is exposed to the same environment as the rest of the body, and the whole surface of the globe becomes covered with skin or dermoid tissue. The cause of the non-development of the lids may be amnion or ovial bands. The less rare forms of ocular dermoid are generally situated in the palpebral fissure or opposite a coloboma of the lid, and this suggests that they may be due to imperfect union of the two eyelids, leaving part of the eye exposed during fœtal life. The growth is a solid tumour with epidermis on the outside and cutis *et cetera*, deeper, not like a dermoid cyst, which has cutis on the outside and epidermis inside. The conjunctival dermoid occurs as an isolated immobile patch in the palpebral fissure area, in the region of the limbus, perhaps straddling it, as in the case here reported. There may be one or two present in the one eye, or one may occur in each eye. Then they are generally symmetrically placed.

Case Report.

In this child, W.R., aged three, the bilateral congenital growths were about the size, colour and shape of a split pea (see Figures I and II). They were fixed to the underlying sclera and cornea. They were almost symmetrically placed on the lower and outer part of each limbus. Fine hairs were present on the surface of each, though hairs not infrequently first show at the age of puberty. The left one had a more or less dry surface from keratinization of the epithelium. Partial atrophy or non-development of the right side of the face was present. The external auditory meatus was absent, and the malplaced irregular piece of pinna is obvious in the figure.

Conjunctival dermoids may enlarge, particularly about the age of puberty, and as the parents of this child considered that the growths were already getting larger and irritating the eyes, each tumour was dissected off. The bare area was covered over its greater part by a bridge of conjunctiva. The operation was performed in 1919. In June, 1933, the patient, eighteen years old, presented himself to inquire whether glasses would improve his sight.

A fairly dense scar now occupies the site of each dermoid, and a thin pseudopterygium encroaches on the cornea to the extent of one millimetre. The scars, however, are far less unsightly than the original tumours and no irritation is experienced. The vision of the right eye is $^{6}/_{12}$ with +1·50 cylinder. The fundus is normal. The vision of the left eye is $^{6}/_{18}$ with a −10 sphere. A complete ring of chorioidal atrophy surrounds the disc; no other fundus defect is visible.

The young man is of the backward type mentally. He, however, works well and earns his living with his father.

The excised tumour was unfortunately lost, so no sections were made. Histologically[3] these dermoids have the characteristics of skin. Beneath a covering of laminated epithelium is dense fibrous tissue, as in the corium, mixed with adipose tissue. In the corium are yellow elastic fibres, hair follicles, sebaceous and sweat glands and sometimes acinous glands like Krause's glands. Blood vessels course through the growth and medullated nerve fibres have been demonstrated in them. The surface cells of the laminated epithelium are keratinized.

Dermoid growths have been met with in the eyes of dogs, horses, sheep, oxen and pigs. In the sheep's eye, wool has been seen springing from the tumour.

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[1] J. Van Der Hoeve: *Transactions of the Ophthalmological Society of the United Kingdom*, 1930, Volume l, page 237.

[2] W. Sinclair: *Transactions of the Ophthalmological Society of the United Kingdom*, 1918, Volume xxxviii, page 142.

[3] Collins and Mayou: "Pathology and Bacteriology of the Eye", page 142.

CASE ILLUSTRATING THE PASSAGE OF OPAQUE MEAL TO GALL-BLADDER, CONFIRMED AT OPERATION.

By FRANCIS L. SCOTT,
Christchurch.

IN May, 1932, I removed the gall-bladder and appendix from a patient suffering from chronic cholecystitis and appendicitis, who had been investigated by cholecystography and barium meal. On opening the gall-bladder I found it full

of barium. The cystic and common ducts were markedly dilated and the gall-bladder was thick walled. In the cystic duct was a freely movable single stone; there was no stone in the common duct. There were no adhesions between the

X ray photograph showing the barium in the gall-bladder.

gall-bladder and the intestinal tract, thus excluding any possibility of a fistulous opening.

In all the literature to which I have access I can find no reference to a similar case, though Professor Graham, of Saint Louis, when I wrote to him, told me that he had heard of one or two such cases.

Graham, Cole, Copher and Moore, in the 1928 edition of their book, at page 245, mention the presence of barium in the gall-bladder due to a fistula between the gall-bladder and the alimentary tract. They also quote George and Leonard as claiming that a portion of the barium meal may be retained for hours in the ampulla of Vater, but not in normal individuals. Kohler (1928 edition, page 492) mentions a case (the patient was not operated on) showing barium in the common bile duct, due, he thinks, to a biliary fistula.

I am indebted to Dr. W. H. Sheffield for the X ray work in this case. The Graham's test showed no shadow. The barium-filled gall-bladder was shown in the X ray photograph (see figure).

The Australian and New Zealand Journal of Surgery.

All articles submitted for publication in this journal must be typewritten and double or treble spacing should be used. Each article should conclude with a brief summary and statement of conclusions. Authors are requested to avoid the use of abbreviations and not to underline either words or phrases.

References to articles and books should be carefully checked. In a reference the following information should be given without any abbreviation: Initials of author, surname of author, full title of article, name of journal, volume, full date (month, day and year), number of the first page of the article. If a reference is made to an abstract of a paper, the name of the original journal together with that of the journal in which the abstract has appeared, should be given, with full date in each instance.

When illustrations are required, good photographic prints on glossy gaslight paper should be submitted. Line drawings, charts, graphs and so forth should be drawn on thick white paper in India ink. Authors who are not accustomed to prepare drawings of this kind, are invited to seek the advice of the Editor if they are in any doubt as to the correct procedure. Skiagrams can be reproduced satisfactorily only if good prints or negatives are available.

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READING, CONFERRING AND WRITING.

"READING", says Lord Bacon, "makes a full man, conference a ready man, and writing an exact man."

As surgeons, we might well reflect on this oft-quoted Baconian maxim, for its underlying spirit should animate many of our ways of professional life.

In truth, in these days of a more than voluminous output of medical literature, reading makes a full man, but the fullness is likely to be associated with grave mental indigestion. One of the best informed men of my acquaintance limits his reading to a couple of surgical journals and a well-known weekly publication, and though this, perchance, may narrow the outlook, it makes for clarity of thought.

A library, to the man in busy practice, should be a place of reference, just as a textbook should be to a student. I know of no more depressing exercise, or one more calculated to develop an acute inferiority complex, than the religious endeavour "to keep pace" with current medical litera-

ture in the mass: the encyclopædic mind is, unfortunately, the gift of few of us, and a judicious particularity rather than an indiscriminate catholicity, should guide our reading.

That conference makes a ready man would be the unanimous opinion of those who attend the meetings of the Royal Australasian College of Surgeons. Our geographical conditions often make attendance at conferences both difficult and expensive, and yet this feature of our College activities has rapidly achieved a gratifying popularity. Well-run conferences should be fostered: they contribute largely, without doubt, to that quality of "readiness", not in dialectics, but in knowledge and resource; a readiness of mind and action which makes for the better treatment of our patients.

Our great master, John Hunter, was evidently an unconscious disciple of Bacon, for he says, in speaking of the benefits of writing: "A man can never tell how much he knows till he arranges his knowledge and then he can tell how defective it is."

Though in the final analysis we would probably agree that much of our present-day medical "literature" confers more benefit on the writer than on the reader, nevertheless it is the duty of those of us who carry on the torch in our faltering way to write, record and compile. In so doing we may be privileged to add a fragment to medical knowledge, and in the doing reap the personal reward of that exactness which Bacon premised and Hunter extolled. Consequently, the New Zealand section of the College welcomes the opportunity afforded it by the Editorial Committee of the Council of putting forward a Dominion number. With few exceptions, in the past our men have displayed a reluctance to contribute to the journal (I almost wrote a creditable reluctance, for one likes to consider it as indicative of the grace of humility), with the result that much useful, and sometimes valuable, material goes unrecorded. It is hoped that the younger men in particular (they contribute largely to this issue) will be encouraged to come forward, for they are the men of the future: they may be assured that their communications will receive a generous welcome from the seniors.

F. GORDON BELL.

Surgery in Other Countries.

[In this column will be published short résumés of articles likely to be of practical value from Journals published in other countries and not readily accessible to surgeons in Australia and New Zealand.]

Fractures of the Neck of the Femur.

The use of a three-flanged nail as practised by Smith-Petersen, Cave, Vangorder and others, has become a recognized procedure in the treatment of fractures of the femoral neck. For the satisfactory performance of the necessary operation it is desirable, particularly in old and debilitated patients, that it should be carried out in a manner entailing the least possible exposure and shock. In order to do this it is essential that there should be a simple and reliable guide which will insure the passage of the nail through the centre of the axis of the neck into the femoral head without undue exposure.

Sven Johansson, of Gotenburg, has carried out a great deal of work to establish this. He has devised a modification of the nail (central tunnel) and a definite technique, both of which are generally known by his name. Other workers have elaborated or modified Johansson's technique. The following extracts from foreign literature will inform readers of some of the work done in this branch of surgery.

A Contribution to the Technique of the Operation of Fracture of the Femoral Neck by the Smith-Petersen Nail (Osteo-Synthesis).

Sven Johansson (Gotenburg), *Zentralblatt für Chirurgie*, August 20, 1932.

After discussing the advantages and disadvantages of various methods employed in the treatment of fractures of the femoral neck, the author sums up in favour of the method embodying the use of the three-flanged nail of Smith-Petersen. He rightly insists that it is important to minimize the severity of the operation and to employ a method which avoids the open exposure of the seat of fracture. This involves the problem of correctly directing the course of the nail. He advocates the use of a Kirschner wire. This is used to direct the course of the nail through the centre of the great trochanter and the neck into the head of the femur. The course of the wire is controlled by taking antero-posterior and lateral skiagrams. This wire then acts as a guide to a special tunnelled (along centre of its long axis) three-flanged nail. Johansson's procedure is as follows: The fracture is reduced (under X ray control) on an extension table. The femoral shaft immediately below the great trochanter is then exposed. A strong wire is introduced axially through the neck into the femoral head, and along this wire a Smith-Petersen nail provided with a central tunnel (Johansson's modified Smith-Petersen nail) is threaded. A Röntgenogram is used to determine the appropriate length of the nail.

The real difficulty is the determination of the correct direction for the introduction of the wire. In the sagittal plane this is carried out as follows: The centre of the femoral head lies from the anterior superior iliac spine half the distance between the anterior superior iliac spine and the *symphysis pubis*—1·5 centimetres. This point is marked with a lead pellet and controlled by an X ray examination. The determination of the direction on the frontal plane is more difficult. The method is based on the results of the investigations of Ostrowski and others, which have shown that with a 30° internal rotation of the

femur (the position of the patella and not the foot is the guide), the femoral neck assumes a horizontal plane, that is, it lies parallel to the surface of the table. With the femur held in a position of 30° internal rotation, the directing wire is introduced along the femoral neck parallel to the surface of the table. Johansson employs a directing apparatus shown in Figure I. The wire is applied to the femoral shaft close below the trochanter, slightly ventral to the mid-line. It is wise to make a little groove at the point selected for its entrance. The position of the wire is controlled by antero-posterior and lateral skiagrams. For the lateral skiagram the tube is placed as

FIGURE I.

FIGURE II.

shown in Figure II. Should the X ray examination show that the position of the wire is not satisfactory, it is then an easy matter to place a new wire in the correct position. With the wire in correct position the special tunnelled nail is

FIGURE III.

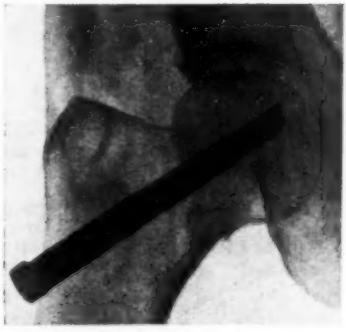

FIGURE IV.

then threaded along the wire. Figures III and IV show the wire and nail in position and are copies of films taken in the antero-posterior position.

Johansson generally employs spinal anæsthesia. After the introduction of the nail he rests the leg between sand bags or preferably places it on a Braun's splint in a position of slight flexion and abduction at the hip.

B. T. ZWAR.

A Contribution to the Technique of the Operation for Fracture of the Femoral Neck (Osteo-Synthesis) after Sven Johansson.

Fritz Krauss (from the Surgical Division of the City Hospital, Amberg, Germany),
Zentralblatt für Chirurgie, April 8, 1933.

KRAUSS regards Sven Johansson's modification of Smith-Petersen's operation as a definite advance in the treatment of fractures of the femoral neck. It was his practice to follow in a general way the method laid down by Sven Johansson. As a result of experience, he has formed the opinion that Johansson's method of controlling the direction of the guiding wire has two disadvantages, namely, a possible risk of over-exposure to X ray radiation and consequent damage and the disadvantage of working in darkness with the accompanying difficulty of insuring perfect asepsis.

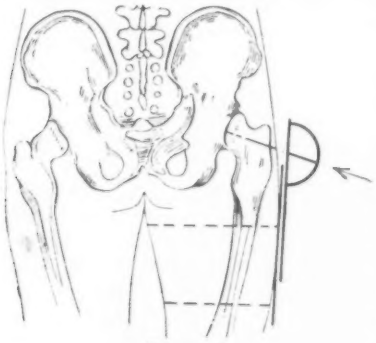

FIGURE I.

To overcome these disadvantages, Krauss has constructed a mechanical guide for directing the guiding wire for the Johansson's modified (Smith-Petersen) nail. The guide consists of a thin metal bar with a slit and two lateral guiding flanges, along which a second bar glides, and on which the second bar can be fastened in any position. The second bar carries a metal protractor

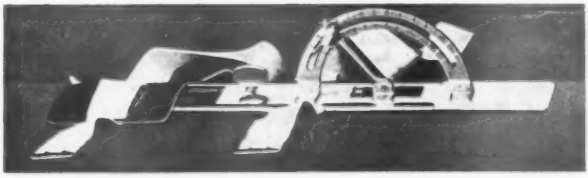

FIGURE II.

with a direction- or aim-tube (Zielrohr). This tube can be placed in any direction occupied by the femoral neck. A portable X ray apparatus is used to place the direction-tube in the appropriate position and to control it. The guiding Kirschner wire is then inserted through the great trochanter along the femoral neck into the femoral head. The instrument can be sterilized by boiling.

The length of the nail can be estimated from the relative length of the femoral head, femoral neck and great trochanter in relation to that of the diameter of the protractor. In the X ray film the length of each will be subject to alteration in the same proportion. Krauss fails to make it clear how he obtains the correct position of the wire in the frontal plane. In the accompanying diagrams *et cetera*, Figure I

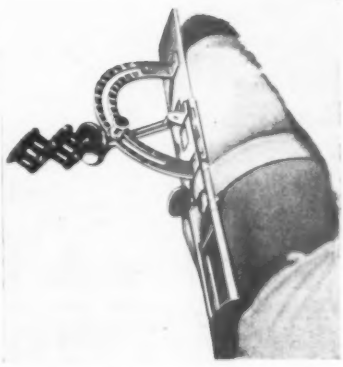

FIGURE III.

shows a scheme of the apparatus, Figure II shows the apparatus, and Figure III the apparatus in use.

B. T. ZWAR.

The Operative Treatment of Fractures of the Neck of the Femur by Sven Johansson's Method: A Contribution to its Technique.

Von Bertel Bager, Oernskoeldovik (Sweden), *Zentralblatt für Chirurgie*, 1933, Number 31.

BAGER modifies Sven Johansson's technique. He employs a simple method which in his hands has proved effective and reliable. Bager fixes a strip of adhesive strapping between the anterior superior iliac spine and the *symphysis pubis* of the affected side. This strapping carries a series of lead indicators in the form of numbers at equally spaced intervals. A second similar strip of adhesive strapping carrying a series of round lead indicators is fixed along the length of the *trochanter major*. After the reduction of the deformity it is an easy matter to determine the exact line through the centre of the femoral neck by means of an X ray film and the use of Sven Johansson's metal director as shown in Figure I (from a point near the numeral 3 and the fourth round lead indicator).

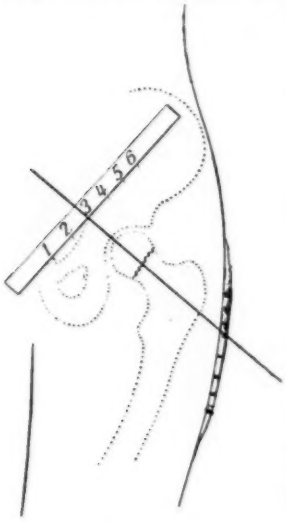

FIGURE I.

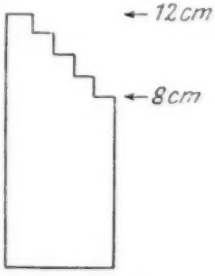

FIGURE II.

In order to determine the correct length of the nail, Bager employs a centimetre scale cut out of lead and ranging from 8 to 12 centimetres (Figure II). When an X ray film of the fracture is being taken *et cetera*, this scale is placed alongside the femur at the level of the trochanter, and at the same distance from the table as the centre of the trochanter for an antero-posterior view. In the film so taken the length which the nail is required to traverse through the trochanter, neck and head of femur, is measured and this length is then adjusted by a comparison with the lead scale projected on to the film; the enlargement of this scale is practically in the same proportion as that of the bone.

B. T. ZWAR.

Reviews.

PHYSICAL THERAPY.

Principles and Practice of Physical Therapy. Edited by HARRY E. MOCK, D.Sc., M.D., RALPH PEMBURTON, M.S., M.D., and JOHN S. COULTER, M.D., F.A.C.S. In three volumes, medium 8vo. Volume I, pp. 602 + xxiv, with 239 illustrations; Volume II, pp. 1,198 + vi, with 2 colour plates and 1,080 illustrations; Volume III, pp. 898 + vi, with 524 illustrations. 1933. U.S.A.: W. F. Prior Company, Inc., Hagerstown, Maryland. Sydney: Butterworth & Co. (Aust.), Ltd., 8 O'Connell Street.

"PRINCIPLES AND PRACTICE OF PHYSICAL THERAPY" comes to us at a time most needed. After a period of empiricism physical therapy has asserted itself as a scientific branch of the art of medicine and surgery. It is receiving recognition as a valuable aid in all medical practice.

These three volumes form a wonderful reference book alike for the busy practitioner and the medical student. They make a very complete textbook of physical therapy for all those interested, from the technician to the specialist. No library indeed could be considered complete without it, and all students taking courses of massage or physical therapy should have access to these volumes.

Some of the matter necessarily is for the physicist alone, some for the orthopædic surgeon, but the greater part constitutes a fund of information suitable for both technician and general practitioner.

The numerous illustrations are of a very high order, and most helpful to an understanding of the text.

The volumes are loose-leaf, so as to provide for additions and revisions which research and experience may from time to time make necessary. Glancing through the list of collaborators, the editors are to be commended on their judgement.

The first volume on the history of physical therapy is an admirable introduction to the book.

Chapter IV, by Bassett, gives an account of the interesting and important recent physiological investigations into the effects of cold and heat, particularly the effect of increase of temperature on circulatory rate and capillary lymph interchange. This chapter will give the reader a better understanding of the chapter on hyperpyrexia by Neymann. Holmquest's chapter on "Sources of Heat" is a masterly work on a subject which has been the arena of much conflict of opinion. Pemburton's chapters on massage clearly indicate some of the many uses of that somewhat discredited art, and show how that field has been in the past, and is being to some extent still, exploited by the unqualified. Coblenz has in a somewhat technical chapter shown the physical properties of the various wave lengths of the electro-magnetic spectrum and their relation one to another. All the work on ultra-violet therapy is valuable, and claims for its use are not made except where it can be justified by scientific facts or clinical experience. The recent popularity of hyperpyrexia in America was inaugurated by Neymann, who, in Chapter XVII, gives an excellent account of the subject from its inception to the present day. The chapter on physical therapy in dermatology shows the wide scope of this form of treatment and gives the correct technique for the best cosmetic results.

In Volume II will be found a mass of valuable information. The importance of physical therapy in the after-treatment of many surgical conditions is shown. The description of the treatment of fractures and injuries to soft tissues is in line with modern thought and practice. The chapter on nerve lesions indicates what is being done with electrotherapy and active and passive movements. The treatment of infantile paralysis with exercises and muscle training as now seen at most clinics is very thoroughly discussed, and should be read with Chapter XIX of Volume III, which gives also the treatment of infantile paralysis with the aid of the therapeutic pool technique. Chapter XI contains ninety pages of information of the most authoritative kind for treatment of such a host of deformities and disabilities to which man's extremities are subject. Chapter XVI, by the editor, Harry E. Mock, deals with another common complaint—backache. After reading this chapter, one can realize the high standard that has been attained in the whole work. One cannot pass Chapters XXI and XXII without appreciating the importance of the special technique in gonorrhœa in male and female patients.

The third volume deals mainly and exhaustively with the theories and indications of treatment by the various "modalities" with technique very fully explained. Many of these chapters should be studied in close connexion with some of the chapters in Volumes I and II. Chapter IV, "The Practical Application of Radiation", gives in concise form accepted ideas on radium, X rays, *Grenz* rays,

ultra-violet radiation, visible light therapy and infra-red therapy, and taken with Chapters VI and VII presents a complete study of radium and X ray therapy.

It may seem a little ungracious to express regret for the brevity of matter dealing with the following subjects: (i) local diathermy with ultra high frequency or "short wave"; (ii) (arthritis), ætiology, pathology and treatment of arthritis; (iii) diathermy of gynæcological conditions; (iv) colonic therapy with a discussion as to the value and relative merits of various apparatus; (v) foam bath therapy. These shortcomings, if we may so term them, will doubtless be remedied in future theses and revisions; for the introduction of these provision has been fortunately made in the loose-leaf system adopted for the work.

The volume closes in a fitting manner with a description of a department of physical therapy and its personnel. Plans of many of the large clinics of physical therapy in America are also given.

Corrigendum.

F. MACKY writes from Auckland that he was incorrectly reported in the issue of January, 1934, at page 302, in the discussion on anæsthesia. His remarks were to the effect that chloroform was used in Auckland for the majority of inductions, but that it was always employed in the form of a chloroform-ether mixture, the relative strengths varying with the individual.

Editorial Notices.

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